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Canada's Parks

Exploring the National Parks of Canada. By Devereux Butcher. Washington, D.C. 1951. The National Parks Association. 84 pages. Illustrated. $1.50.

In this attractive, paper-bound book, Devereux Butcher covers the national parks of Canada in the same effective manner in which he described those of the United States in his popular *Exploring Our National Parks and Monuments.* Beautifully selected and splendidly reproduced pictures supplement the text, which both describes the parks, and what is to be found within them, and provides practical and useful information on reaching them and on the facilities to be found there. Through the whole book runs the thought of the ideals upon which parks are set aside as sanctuaries for wildlife and for the preservation intact of outstanding scenic assets.

Technical Libraries

Technical Libraries, Their Organization and Management. Edited by Lucille Jackson. New York. 1951. Special Libraries Association, 31 East 10th St. 202 pages. $6.00.

The publication of this book represents the culmination of a long-term special project of the Science-Technology Division of the Special Libraries Association to compile a manual of practice for the establishment and conduct of technical libraries. The material gathered covers staffing, budgeting, laying out and equipping, selecting material, administration, classification, documentation and reference procedures.

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Nature in Print

By HOWARD ZAHNISER

IN THE midst of another crisis in the history of our efforts to preserve some of our original American wilderness, it is most encouraging to note the ever-increasing public interest in those areas that are being protected by our federal government. To see this interest reflected in the publication of more and better books on the national parks is particularly gratifying, not only because thus are multiplied the numbers of those informed citizens who will demand national park protection, but also because the opportunities for experiencing these superlatively precious areas of our preserved wilderness in the writings of others are likewise thus increased. For most of us who even are unusually concerned with this preservation, each park is most likely the scene of only a once-in-a-lifetime experience. To intensify the expectation of this experience, enhance the experience itself, or to enrich and renew its recollection — through the books of informed and articulate interpreters — is the distinctive privilege of readers, as is also the chance to know in print the areas that we ourselves may never be able to see in the landscape. To know these areas merely in literature or photography is to want them safeguarded. To see the excellent new volumes being issued by our publishers and to sense the heightened public appreciation that must follow is to have added hope that their protection will be assured. Thus we welcome all worthy new books on the national parks and wish for them many, many readers.

Encouraging indeed is it to see a new and improved, a third, edition of Devereux Butcher's *Exploring Our National Parks and Monuments*, discussing now not only the 28 national parks and the 38 areas that Mr. Butcher designates "national nature monuments," but also 18 "national archeological monuments" not included in the two earlier editions. Exquisitely illustrated with close to 300 halftones well printed from photographs, nearly a hundred of which are from the author's own camera, the book is a clear-cut, factual presentation of each area's characteristics, with emphasis on fauna and flora. Arranged alphabetically within the book's three major divisions, the descriptions of the specific areas include directions for reaching them and comments on accommodations. The book is superbly pleasing on first "reading" for its photographs, and lastingly useful for reference, either in travel or on the shelf. Its pleas for preservation are persuasive, and its indications of threats and dangers, while unobtrusive, are inescapable. Mr. Butcher, editor of *National Parks Magazine* and field secretary for the National Parks Association, is both ardent in his appreciation of our great areas of wilderness and zealous in their protection. His book is accordingly both a testimony to his appreciation and a well-fashioned means for advancing his preservation purposes. It is gratifying to all preservationists to see it growing in new editions.

It also is good to see the new publication, the "mid-century edition," of Irving Robert Melbo's *Our Country's National Parks*. Issued in two volumes of large pages and in large type, which give a reading ease to its text and special effectiveness to its 160 photographs, this work is especially suited for young readers and for adults who wish a straightforward, simple and humanly interesting account of the dramatic features of our 28 national parks and the lore of their history. In addition to an outline map in each of the two volumes showing the location of all the national parks, there are interesting and helpful sketch maps for all the individual parks except Big Bend and the Everglades. Dr. Melbo, a professor of education at the University of Southern California, tells us that his work "was first planned in the cool depths of the Carlsbad Caverns" with the realization there "that each of the great national parks has something of special interest and significance to all America, and particularly to the youth of the land." Grouping his park-by-park chapters in nine sequences to emphasize the common interests that some parks share, Dr. Melbo has been notably successful in his effort to present his information "in a thoroughly enjoyable and readable form." In his sequence "The Old Fire Monsters," for example, the chapter on Lassen, during one Sunday afternoon of my own enjoyment of this work, proved almost as readily readable (aloud) for my eight-year-old Karen as did the Crater Lake and Mount Rainier chapters for her older sister and brother, or the Hawaii account for their father. "There is no reason," comments Dr. Melbo, "why books on the national parks should be uninteresting," and in his own work he has well demonstrated the soundness of his comment.

Success in not only presenting an understanding of what our parks are, and in not only demonstrating how interestingly they can be discussed, but also in giving them an interpretation and a place in our culture, in our philosophy, is the achievement of Alfred A. Knopf's newly published "definitive" work by Freeman Tilden entitled *The National Parks: What They Mean to You and Me*. Its publication is an outstanding event in wilderness preservation, for its influence should be not only to attract a wider and more intelligent interest in the national parks, but more especially to define in unmistakably clear terms the significance of the national parks — to make understandable to all who read and think that in wilderness preservation is not merely a provision for an especially pleasant and healthful sort of recreation, but, more deeply, the maintenance of access to the sources of our true living. No one reading this work will continue to feel that our national park system is most important for its wonders, its spectacles — marvellous as these are. The novelist, short-story writer, and humorist, Freeman Tilden, who a decade ago was named by Newton B. Drury a collaborator and consultant of the National Park Service — "the widely traveled, widely read New England gentleman, sensitive to beauty and a student of nature's relation to human affairs," as Mr. Drury himself describes Mr. Tilden — has, indeed, definitively in this book revealed a significance much deeper. He integrates a regard for these wildernesses into all our best purposes, individual and social. The national parks, says Mr. Tilden, "are not merely places of spectacular scenic features and curiosities. . . not merely places of physical recreation." He, does however, comment that "if finer and more re-creative recreation can be found anywhere in the world, the spots have not yet been revealed." The deepest value of these areas he sees in the preservation of our natural "life community."

"Their purpose," he apprehends, "is to *preserve*, in a condition as unaltered as is humanly possible, the wilderness that greeted the eyes of the first white men who challenged and conquered it. It is to insure that the processes of nature can work, without artifice, upon all the living things, as well as the earth forms, within their boundaries. It is to keep intact in the wilderness areas all the historic and prehistoric evidences of occupation by our predecessors."

"In doing these things, the extra reward of recreational value emerges," says Mr. Tilden, and in so saying he reveals the true nobleness of the national park concept, so misunderstood by those who for their own purposes would consider these wilderness preserves as playgrounds that can readily be used as reservoir sites, or for other materialistic purposes, and as readily replaced with some other facility for pleasant play.

Yet, as in the parks themselves, in Mr. Tilden's volume, too, these deeper enrichments are perceived through good-humored enjoyment and the exciting and interesting experience of wonders,

To A Redwood

By HELEN H. CAMP

I always felt that I had trod
The noble earth
And walked with God,
Until I saw with naked eye
Your majesty against the sky.
And then within my heart
I thought
I knew my God,
But knew him not!

marvels, spectacles, and scenic wild grandeur. Only in its introductory presentation of the life community concept and in its *l'envoi* are these deeper meanings made literal. Mr. Tilden's presentation of the facts and meanings of the 54 national park and monument areas which he discusses is interesting throughout, enjoyable, and satisfying.

"When many years ago," he writes, "I made my first visit to a national park, if I had any definite idea at all about it, it was 'for to see and for to admire" those things which had been pictured and described to me, and in a general way for what I thought of as a holiday recreation. If I had anything faintly resembling an intellectual or spiritual approach, I certainly cannot recall it. And to this day I should suggest that one beware the intellectual and studied attitude. It is self-defeating and an enemy of joy. The first contact with the wilderness parks, at least in their wilderness aspects, should be as round-eyed as that of children. The deeper meanings of what is seen will come in their proper time."

On his first visit to Yellowstone Mr. Tilden realized that "behind the visual was the soul of the thing — a unity more beautiful than the falls, more mysterious than the geyser basins, more prodigious than the canyons." In the other parks that he has visited the experience has been similar. "As for the beauty," he now testifies, "it never palls; as for the sense of healing quietude, it is never lacking; as for the meanings, I am still at school; but the parks have provided me with much of the most refined satisfactions of my life."

May we not hope that our national experience as a people will prove similar to Mr. Tilden's and that "in their proper time" will come to our legislators in Congress and to our administrative officials (even those in our Bureau of Reclamation, in our Corps of Engineers, and in our timber management divisions and recreation units) "the deeper meanings of what is seen" in our great system of unspoiled wilderness? Surely Devereux Butcher's exquisitely pictorial and factually apt new edition of *Exploring Our National Parks and Monuments*, Irving Robert Melbo's appealing account of *Our Country's National Parks* with its special value for younger readers, and Freeman Tilden's inspiring contribution to our literature will hasten the time when the meaning and true value of these areas unspoiled will be so generally appreciated that no representative of the public can sanction or even tolerate the despoliation of these national treasures. Such works are welcome now indeed, when the scenic wild canyons of our Dinosaur National Monument are threatened by the Bureau of Reclamation promoters of the Echo Park dam, when the security of our whole wilderness preservation system is thus in jeopardy, when if ever the need for an alert and informed public is tense and great. May these works be well read, and may their readers in turn become writers — writers especially of letters to their Representatives and Senators in Congress. In such writings are our democratic hopes for the preservation of these "crown jewels" of our democracy.

Exploring Our National Parks and Monuments. (Third Edition.) By Devereux Butcher, under the auspices of the National Parks Association, with 3 contributed chapters ("We Need Wilderness," by Sigurd Olson; "The American Indian," by Frank H. H. Roberts, Jr.; and "International Activities in the Protection of Nature," by Harold J. Coolidge). Boston: Houghton Mifflin Co. 1951. 286 pp. (6¾ by 9½ in.), with 276 photographs (93 by the author), 10 decorative drawings by the author, 3 outline maps by Bess O'M Mac Maugh, classified list "For Further Reading," and index. $2.50 in paper covers.

Our Country's National Parks. (Mid-Century Edition.) By Irving Robert Melbo, with introductory note by Newton B. Drury. Indianapolis and New York: The Bobbs-Merrill Co., Inc. In two volumes (7¼ by 10¼ in.). VOLUME ONE: xii + 284 pp., with 88 photographs, 15 outline maps, and index. $3.50. VOLUME TWO: xii + 244 pp., with 72 photographs, 13 outline maps, 13 sketches ("How Yosemite Valley Was Made," "How Crater Lake Was Made"), and index. $3.

The National Parks: What They Mean to You and Me. By Freeman Tilden, with an introduction by Newton B. Drury. New York: Alfred A. Knopf. 1951. xviii + 417 + xxi pp. (6¼ by 9⅝ in.), with 36 photographs on 32 plates, outline map, area-by-area summary of "information for tourists" on each of the 54 parks and monuments included in the volume, glossary, list of 187 areas administered by the National Park Service, and index. $5.

Protection of Nature

Proceedings and Papers of the International Technical Conference on the Protection of Nature. Brussels, Belgium. 1950. Available from Miss Susannah Coolidge, 1355 Brush Hill Road, Milton 86, Mass. 583 pages. $3.50.

This collection of the proceedings and papers of the Lake Success Conference of 1949 is valuable as a reference work on many conservation problems in many parts of the world. Many important papers were delivered at the sessions, or were contributed by leading authorities. These are supplemented by the exchange of information through the questions and answers at the various sessions, which were devoted to a variety of important subjects. This book should be in every public library, as well, of course, in the library of anyone interested in conservation. Copies are made available on a non-profit basis as a contribution to international conservation.

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Wildlife and Plants

American Wildlife and Plants. By Alexander C. Martin, Herbert S. Zim and Arnold L. Nelson. New York. 1951. McGraw-Hill Book Company. 500 pages. Illustrated. $7.50.

This is a guide to the wildlife food habits of North American birds and mammals, and brings between covers for the first time the wealth of knowledge that has been accumulated on the subject of plant-animal relationships. While it is a text of particular value to wildlife technicians, it is likewise of immense value to sportsmen, naturalists, bird students, sanctuary owners, foresters, landscape architects and botanists. It is also a notable addition to the conservation library, since the future of our wildlife resources depends so vitally upon acceptable habitat that offers proper food for its occupants.

The Horse

Horses. By George Gaylord Simpson. New York. 1951. Oxford University Press. 247 pages. Illustrated. $6.50.

This is the story of the horse family, today and through sixty million years of history. Dr. Simpson, who is chairman of the Department of Geology and Paleontology at the American Museum of Natural History, divides his book into three main parts. The first part discusses horses and the present-day members of the horse family. It covers the origins and history of domesticated horses, centering interest in the horse itself. The second part discusses the prehistoric horse, reconstructing its story from the evidence of fossil remains. The third part of the book is concerned with horses in the evolutionary sequence. This is an outstanding, readable and interesting book.

Conservation Practice

Practice of Wildlife Conservation. By Leonard W. Wing. New York. 1951. John Wiley and Sons. 412 pages. Illustrated. $5.50.

In this book the author, a wildlife management technician, presents a text that is of notable value not only to the student but to the conservation worker, and to the individual with a lay interest in conservation of wildlife. Dr. Wing covers both theory and practice, and presents the facts of the ecological approach to wildlife management. He avoids the "jargon" that has grown up among some technicians, and, as a result, the text is clear and consequently the more valuable to the user, whatever his background in this field.

Family Friends

"Introducing Dottie and Toby" is a small pamphlet telling two little stories about Dottie, a fox terrier, and Toby, a Boston terrier. It is the work of Margaret S. Hitchcock, and is published by the William-Frederick Press, 313 W. 35th St., New York 1, N. Y., at one dollar.

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By Way of Report

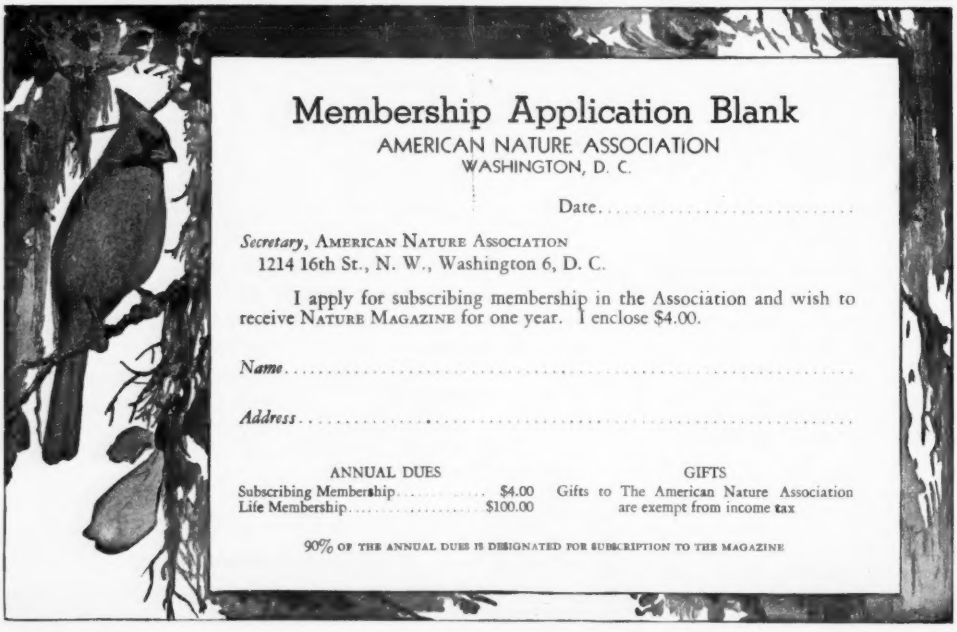
EVER since the organization of the International Union for the Protection of Nature in 1948, in Fontainbleau, France, and the establishment of headquarters in Brussels, a great problem has been to acquaint people generally with the world problems of Nature protection and the aims of the Union in meeting these issues. At the Second General Assembly of the Union, held in Brussels in October, 1950, considerable discussion was devoted to this question. The upshot of this is that Richard W. Westwood, President of the American Nature Association, has been appointed Chairman of the Publicity Commission of IUPN.

Announcement is now made of a grant by the American Nature Association, with the cooperation of the Charles Lathrop Pack Trust, to implement the work of this Commission. A two-year program of information and publicity is being launched, with a representative of the Commission in the Brussels office serving as a liaison officer. Informational news releases, and bulletins will be issued, and material made available for magazine articles, and for radio and television programs. Headquarters of the Commission will be in the Washington office of the American Nature Association, and the names of other members of the Commission will be announced later.

ANNOUNCEMENT is also made by the American Nature Association of a special grant for educational purposes and having for its special objective to facilitate the publication of a series of popular booklets on the common trees, birds, mammals and flowers of our national parks and monuments. This work is being made possible through a matching grant from the New York Zoological Society, and will be jointly administered by the two organizations. Recipient of the grant is Henry H. Collins, Jr., and the first booklets in the series will be ready for distribution in the parks before the opening of the 1952 season.

HARRY E. Radcliffe, Vice-president of the American Nature Association and Treasurer of the Natural Resources Council of America, will represent the Association at the annual meeting of the Council, which will be held October 1 at the Coweeta Hydrologic Laboratory and Watershed Management Research Project in North Carolina. The business sessions will be supplemented by a field trip for inspection of the project.

AS A member of a special committee on grasslands legislation of the Natural Resources Council, Mr. Westwood took part in a meeting perfecting legislation looking to the establishment and administration of typical grassland areas. These areas would be preserved "(1) for research into their vegetation, natural fauna and other factors relating to the use of similar areas for grazing, agriculture and other purposes; (2) as check areas as guides for conservation and land use programs; and (3) for educational and other purposes deemed advisable and pertinent to their use."



Membership Application Blank

AMERICAN NATURE ASSOCIATION
WASHINGTON, D. C.

Date.....

Secretary, AMERICAN NATURE ASSOCIATION
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I apply for subscribing membership in the Association and wish to receive NATURE MAGAZINE for one year. I enclose $4.00.

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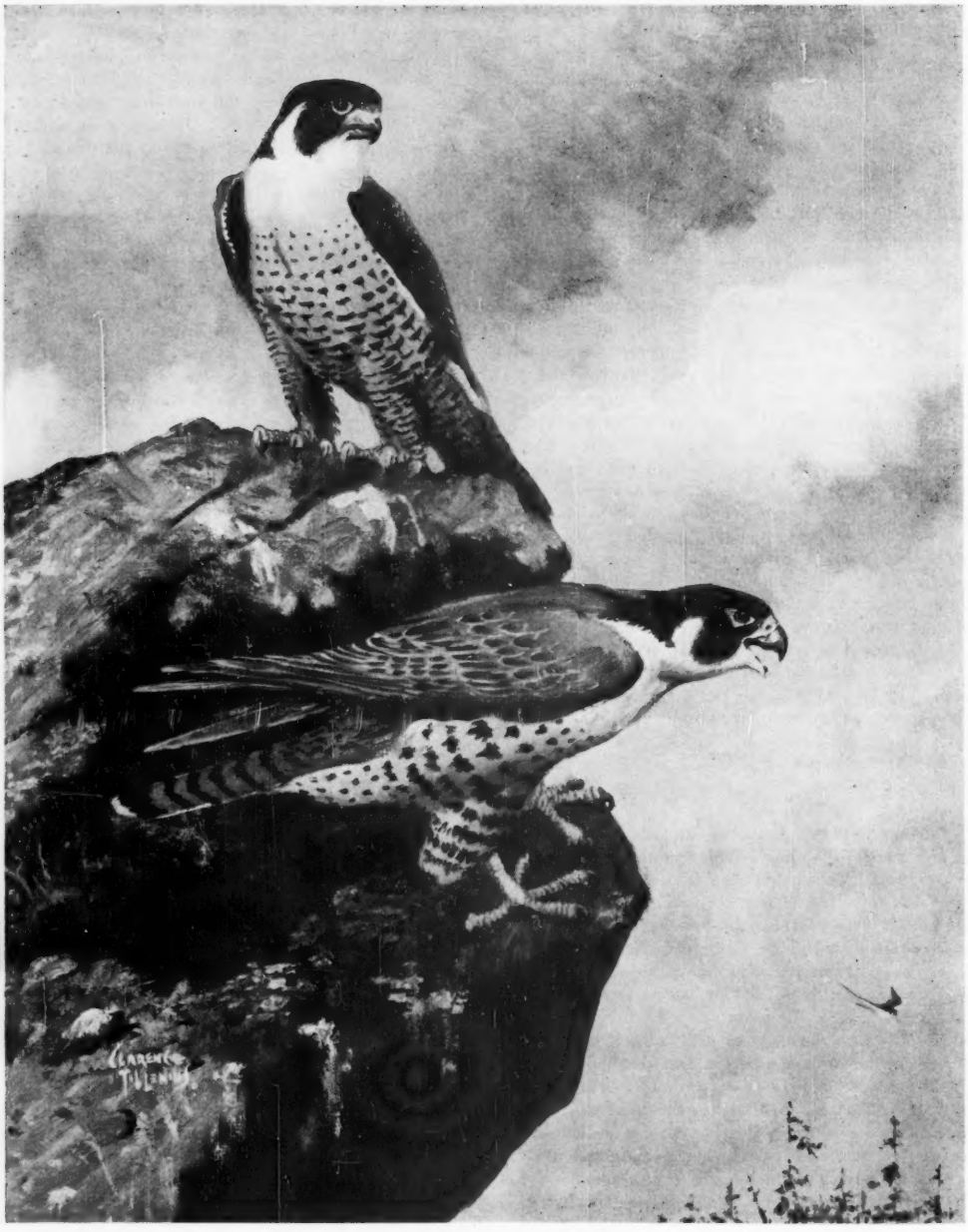
Contents Noted

WALT Disney has done it again with the third film in his motion picture series of True Life Adventures, which was introduced with "Seal Island" and "Beaver Valley." This third in the series is called "Nature's Half-Acre," thirty-five minutes of colorful and dramatic Nature pictures. This is not the story of any one half-acre, and the Nature found on it, but of many half-acres, any one of which might hold some of the birds, flowers and insects shown in the film. There were a few who failed to enthuse about the musical background of "Beaver Valley," feeling it to be contrived and a bit condescending to the wild actors. We did not resent it because we felt that it added to the general popular interest in the film. The musical treatment in "Nature's Half-Acre" is, we felt, appropriate and adds definitely to the enjoyment of the film. If we were to venture any criticism of this latest film it would be to wish that a few more of the flowers, insects and birds had been identified in the narration, which, incidentally, is excellent. We feel that no few people are going to wonder about the identity of a number of the bird and insect actors. Perhaps the present minimum of identification will be an advantage in that it may stimulate further exploration. Everything could not have been identified, of course, but we think there could have been a bit more than is now the case. The film is, of course, not a cartoon but actual photographs of Nature in natural habitat. RKO officials tell us that inquiries are received steadily as to where "Beaver Valley" may be seen. "Nature's Half-Acre" should be equally enduring.

FOR some time now there has regularly come to our desk a copy of a unique newspaper-magazine called *Calico Print*. This publication is devoted to "Tales and Trails of the Desert West," and is edited by Harold and Lucille Weight. It is published each month by the Calico Press, Pasadena 20, California. Subscription is $1.50 a year. There is a good deal of Nature emphasis in the pages of this publication, as, of course, there must be in view of the locale treated. For example, an issue at hand includes an article by Mary Beal, botanist of the Mojave, about a visit that John Burroughs paid to her beloved desert, and to the ghost town of Calico and the Calico Mountains. In the same issue the editors register a strong and much-needed plea for the little desert burros, which are used for targets because the impression — a false one — is current that there are large herds of them wandering the western deserts. The Weights urge establishment of a burro refuge in the Calicos. And why not?

SOUTHBRIDGE, Massachusetts, boasts a young naturalist by the name of Real Brunelli, who writes us insisting that we use his plea for the frog, and right away, too. We hasten to comply. Real asserts that it is about time someone said something for conservation of the frog, and did something to stop the killing of our "green friends." People, he urges, should know how truly beneficial frogs are, and that "they are an example of Nature at its best." He says that he has "seen piles of frogs killed with a gun and left on shore to suffer and then die. (sic) I even saw people torture and kill large bullfrogs. When I say 'people' I don't mean children but 'grown ups' with less knowledge than the frog itself. Again I have seen boys hunt them, not for their legs as a food, but just for the fun of killing them. I think that if one of these killers of nature would take a frog home as a pet and give him all the care needed, he would come to love his pet frog and he in turn would do what I am doing now, spreading the conservation of our 'green friends' the frogs." We promised Real we would let him say his word for the frog, and we are with him in his crusade. We like to see and hear frogs ourselves.

IT IS apparent that the current strategy of the proponents of erection of Echo Park and Split Mountain Dams within the boundaries of Dinosaur National Monument is to build a backfire against the blaze of conservation sentiment opposing the invasion of this National Park Service area. This strategy takes form in giving publicity to statements *for* the proposed invasion. A group of forty-five State officials of Colorado, for example, were taken on a fourteen-hour inspection of the area and were reported in the *Denver Post* as returning 100 percent sold on the dams. Cleland Feast, Colorado's State Game and Fish Director, is quoted as saying that the huge lake to be formed behind Echo Park Dam" will back Lake Mead right off the map." Jeff Wild, secretary of the Upper Colorado Commission, is quoted as asserting, "naturally I hate to see this wilderness area destroyed, but it has to be; the compensating aspect is that there will still be beauty here and it will be of greater value than it is now because it will be accessible." Particular emphasis is being placed on accessibility, and on the recreational value of the resulting lakes. The area would long since have been made accessible had the National Park Service had funds to make it so, and we have yet to see a case where man's creations have added beauty to a natural wilderness. In none of the pro-dam publicity is there any mention of the wide danger involved in the precedent established by invasion of the Monument, probably because there is no answer to this, and because the Bureau of Reclamation would welcome such precedent. In any event, legislation to implement this project apparently has been awaiting adequate publicity designed to offset the conservation sentiment aroused against the proposal, which has logical alternatives so far as perfectly feasible and, indeed, less expensive sites for dams in the much-needed Colorado system are concerned. These alternatives, however, are zealously ignored. —R.W.W.



A pair of American peregrine falcons on the high aerie. Tercel is a term used in falconry to denote the male hawk, while the female hawk is called the falcon.

TERCEL, King of the Air

By A. MARGUERITE BAUMGARTNER

Illustrated by Clarence Tillenius

ACROSS the gray of a turbulent March sky a wedge of geese flapped northward toward the open waters of the Lake. Fifty strong, strung out in a wide V behind their leader, their heavy bodies drove steadily into the wind with the majesty and resolution of a fleet of battleships.

High above the geese, a tiny speck hung for a moment against the sky on suspended wing, then plummeted with meteoric speed. Unerring and relentless as an avalanche, the duck hawk smashed his mighty talons against the unsuspecting body of the lead goose. Before the wedge could scatter, their leader had crumpled to the ground and Tercel was upon him, plucking the feathers in great patches, ripping voraciously at the rich fresh meat. Here was a meal fit for the King of the Air, a fowl several times his size, yet helpless as a canary before the power and precision of the falcon's attack.

Rapaciously Tercel fed, for he had traveled far that day, driven northward against the gale by an impulse stronger than wind or weather. The scent of spring perfumed the wind, the sun glowed with its promise, and within his wild heart the peregrine knew that he must leave the white beaches of the South, where the flocks of sandpipers and ducks on which he had preyed all winter were disappearing on the northern horizon. He knew, as surely as he knew the feel of the wind rushing through outstretched wings, that he must return to the wooded hills and winding valleys and the long blue reaches of the Finger Lakes.

But not, he learned, to the same wild glen where he had first tried his wings a year ago. Indeed, as he sailed up the wintry valley to which he had been drawn with the irresistible force of a magnet, he was met in mid-air by a screaming pair of peregrines. Gone forever the parental solicitude for him, their offspring, they saw in him now only a competitor in their nesting territory. All the same to Tercel, for as yet one place was as good as another. With a few rapid strokes of his long pinions he had risen high above the glen and was drifting with the air currents, through the divide to another valley.

It was here that he came to rest for the night, perched on a dead limb of a gnarled old oak at the edge of the woods that blanketed the hillside. Hunched among the sere brown leaves that still clung to the old oak, Tercel became a stub against the dusky sky. The streaked brown back that marked him as a bird of last year melted into the last year's foliage. The bold black moustaches drooped insolently over the white chin and breast. Brown eyes blinked and closed, and blinked.

A shadow glided out of the woods behind him, almost brushing his head with broad, silent wings. Killer of the midnight woods, a great horned owl was sailing out on its first foray for the evening, a rival no peregrine would tolerate. What mattered it to Tercel that the owl had inhabited this piece of woodland for months, perhaps for years? Today the sky and all that lay beneath was his — Tercel, King of the Air. With an angry scream Tercel sprang from his perch, but the owl slipped into the dusky woods to safety. A duck hawk cannot risk a broken pinion, and Tercel returned to his stub.

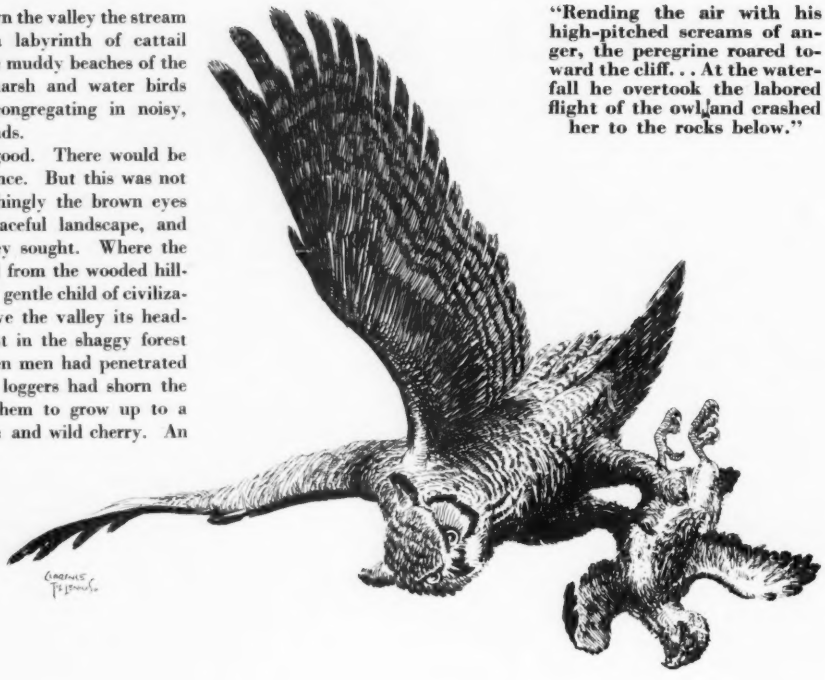
The duck hawk dove, as unerring and relentless as an avalanche.

As the sun rose over the hills next morning, golden and glistening on the rising mists, Tercel saw that this was a home fit for majesty. With long pinions beating rapidly he catapulted himself into the wind, rose into the chill upper air and hung motionless, looking down upon the kingdom into which he had drifted.

Below him spread the wide Sunnybrook Valley, a mosaic of plowed fields and pastures splashed with the first greens of spring, crisscrossed by the meandering stream. The white ribbon of road was dotted at intervals with neat farm houses, red barns and sprawling hen

houses. Far down the valley the stream lost itself in a labyrinth of cattail swamps and the muddy beaches of the Lake, where marsh and water birds were already congregating in noisy, careless thousands.

Yes, it was good. There would be food in abundance. But this was not enough. Searchingly the brown eyes studied the peaceful landscape, and found what they sought. Where the stream emerged from the wooded hillside it became a gentle child of civilization. But above the valley its headwaters were lost in the shaggy forest that not a dozen men had penetrated since the early loggers had shorn the hills and left them to grow up to a jungle of aspen and wild cherry. An



"Rending the air with his high-pitched screams of anger, the peregrine roared toward the cliff. . . At the waterfall he overtook the labored flight of the owl and crashed her to the rocks below."

almost perpendicular hill rose forbiddingly out of the valley, into which the stony, weed-choked stream had eaten its way until at last it met its match in the solid rock wall of the upper glen. Here a thin film of water dropped mistily over a cliff into a vast, forgotten amphitheater shrouded by the silent woods. Among the crags and crevices of Forgotten Gully Tercel would found his aerie.

As he dove downward toward his chosen retreat the sheer exuberance of spring raced through his veins. Plunging earthward with unbelievable speed, he checked his descent abruptly at the very face of the cliff, veered upward with a triple loop-the-loop and roared skyward, to do it all over again.

Wearying at length of his sport, he came to rest on a rock above the waterfall. Here, too, there would be food close at hand for the family he would some day have. From the woods echoed the throbbing drum of a grouse, beating his song of love upon the quiet air. A bluejay's raucous cry was answered by another farther upstream.

A flicker started its jerky flight across the amphitheater. Quick as light Tercel was into the air, bearing down upon the smaller bird with the speed of a bullet. Passing beside it, the peregrine shot out his great yellow talons with a deft halft-wist, and continued on the flicker's path, a limp body dangling from his claws. Returning to the cliff, he tossed the bird upon one of the rocky shelves and sent a shower of yellow feathers into the wind as he plucked and gulped down his hapless victim.

And now, with hunger appeased, a great longing came over Tercel. There should be another to share his rocky wilderness, to soar with him over the fertile valley, so rich in its promise of food. Eagerly he scanned the horizon, but no slim shape appeared, flying swift and sure on sharp, pointed wings. Ducks scudded down the valley, fat brown bodies nosing northward. Clouds of blackbirds circled over the meadows and settled noisily in the cattail swamps, creaking and whistling companionably. A flock of robins, ready to scatter to their respective gardens, passed almost over his head. But Tercel's hunger was not of the body.

Days passed, and the lonely peregrine hunched stolidly upon his perch. Pussy willows lounged in the sunshine along the stream. A pair of phoebes below the waterfall proclaimed their identity with persistent egotism. A band of crows screamed from the woods above the amphitheater. They had found the horned owl's perch, and were making life miserable for their ancestral foe. Tercel, too, would have liked to pursue this other marauder, but as long as it sulked in the shelter of the woods the duck hawk was powerless to destroy it.

Suddenly Tercel's brown eyes dilated and his every muscle tightened. With a rusty wail he launched himself into the air and began to sail excitedly back and

forth, down to the valley, back up the glen to the cliff, back to the valley. High over the divide to the southward a dark speck was growing steadily larger, a speck that only the telescopic eye of a duck hawk would recognize as one of his kind, and only a lonely male would identify as one of the opposite sex. As she came closer his sallies became more frantic, and a coaxing tone came into the rusty "Wi-chew."

She was an older bird than he, dark gray above where he was brown, almost white below; a beautiful creature, with white chin glistening in the morning sun, contrasting sharply with the black bands of her cheeks.

But she flew on, down the Sunnybrook Valley and far up the Finger Lake, without so much as a pause at the wild, hidden cliffs of Forgotten Gully. With a last sad wail the rejected peregrine returned to his perch and hunched like a dead stub until hunger drove him again to the valley.

But there came a day, at last, as March was mellowing into April, when another came up the valley through a soft gray mist and an early twilight. Tercel was just returning from a foray to a field of new wheat where the crows were feasting, impudent and off their guard in the very teeth of a flapping scarecrow. Thus he did not see the newcomer until she was almost opposite the hidden glen.

A young bird, brown like himself, a young bird with no ties to the cliffs of another valley or the tundras of the north! Swooping up to her line of flight, like a madcap schoolboy, he veered a foot from her face, looped the loop and came up beside her with a triumphant half-twist. "Wi-chew," he announced in his most hospitable tone, and led the way up his wild little glen to the amphitheater of rock by the waterfall. Wailing his rusty note again and again, he sallied excitedly from one rocky shelf to another, alighting for a moment, then sailing on to the next, coaxing her on with a gentle "wi-chew."

And so Tercel won his mate, Falco, the brown peregrine, trim and sleek and silent, a little larger than he, as is the custom among hawks, and every inch as fierce and free. But try as he might, he could not arouse in her the ardor, the urge that overflowed his being, to select one of these chosen clefts and settle down upon it.

Day after day she sat passively upon a dead stub overlooking the waterfall and the amphitheater. Each morning Tercel would soar out across the valley and return with a rich prize — a pigeon from the flocks that careened in the spring air high above the red barns; a bluejay or flicker from the edge of the woods; an unwary crow. As he returned he would announce his arrival with a high, musical note, "aaaaaaa," and she would dart out to meet him. Swooping by with a half-twist of her lithe body, she would snatch his offering as he dropped it to her in full flight. No gentle courtship, this, but savage and unrestrained, as befits a peregrine!

And then, all eagerness, he would make the rounds of the rocky shelves, dusting this one, scratching among the debris and loose shale on that, coaxing her with plaintive "wi-chews" to come and see its beauties for herself. Sometimes he would work for hours, scraping and scratching about a niche, or sit on the edge and wail plaintively to his indifferent mate. Then, unable to curb his passion longer, he would dart across the amphitheater, mounting with the upward drafts until he was lost in the clouds, then plunge down from his dizzy heights and roar past the cliff.

Sometimes she joined him in his exercises, and then his exuberance knew no bounds. Diving into the wind, he rolled over and over, darting upward, rocketing down with breath-taking abandon, soaring up, up, hundreds of feet above the cliff, then plummeting down with a roar in his outstretched wings. All the pent-up emotion of the past month was driving him from one mad revel to another.

Finally came a day when she followed him to one of the rocky shelves. Then the falcon's "wi-chew" was uttered with the ingratiating cadences of a salesman displaying his dream house. But this stony cleft in the hillside did not suit Falco at all. With a querulous squawk, she sailed to another. Here she scratched about for a few moments, then moved on to a third. But none seemed right to this fastidious queen. Moodily she returned to her roost tree.

The next day was the same, and the next, but as the April sun warmed the ledges, and new leaves began to unfurl along the borders of the woods, *her* heart, too, began to warm. She began to explore the stony face of the cliff with new diligence. At last she chose a narrow ledge that Tercel had never seen, just above the waterfall, where the stream had eaten only a narrow channel. Tucked securely into an overhanging crag, small enough to be cozy, yet deep enough to be secure for active fledglings, she could look from its rim out over the amphitheater and woods, and across the whole broad panorama of Sunnybrook Valley

It was a worthy cradle for the sons of

royalty. Busily Falco hollowed a shallow scrape, about an inch deep and a foot in diameter, in the dead leaves and debris at the upper end of the shelf. Sheltered by the overhanging rock, it was further concealed by a clump of ferns and a sapling birch that had taken root in the weathered face of the cliff.

Roaring up the glen a few days later in a late spring sleet, Tercel found her reluctant to leave the aerie, although she had always come at his feeding call. The reason lay in all its fresh bright loveliness upon the scanty nest — her first egg, a smooth, creamy oval heavily washed with rich mahogany spots and blotches.

As he gazed down upon it she uttered a soft note and flew off down the glen. He, then, was to be allowed to share the responsibilities of their home. Carefully he squatted over the precious egg, while a thin film of sleet filtered into the cavity and coated his brown back.

Two days later she laid another, and in time there were four handsome eggs in the aerie in Forgotten Gully.

Falco settled down in earnest, seldom leaving the nest except to dart out into the amphitheater to receive the birds with which her mate kept her bountifully supplied.

Now there were long quiet days, while a green mantle spread over the hillsides and the valley was carpeted with spring beauties. The birch sapling at the nest shelf rustled with crisp new foliage, and at its roots a cluster of blue hepaticas imaged the April skies.

At the foot of the waterfall the phoebes were nesting now, indifferent or oblivious to the menace above them. New voices echoed among the trees, as wave upon wave of the smaller song birds, in infinite number and variety, crowded the May woods.

The full moon waned and grew to full, and waned again, while Falco sat patiently upon her precious charge. Occasionally he joined her, entertaining her with a few soft cackles before he swept off to his watch of the glen again. Sometimes during the last week or two she left the eggs under his protecting wing while she exercised cramped muscles and stooped for pigeons in the valley.

Then one day life stirred beneath her breast. Peering down, she beheld her first-born, a small wriggling creature clothed in short creamy down. Blind and helpless as a day-old kitten, it sprawled in the rocky scrape, legs gangling and spindling neck striving in vain to lift the heavy head.

Carefully Falco tucked it beneath her breast and called Tercel with a series of excited "quak-quak-quak's." His answering note drifted musically up the glen, and soon he landed with a soft thud on the rocky shelf. Together they watched their chick, bracing itself on scrawny winglets, so tiny, yet already asserting claim to sovereignty with bold, if baby-like squeaks.

Reaching a talon for Tercel's most recent offering, the mother picked off tiny shreds and touched them to her baby's beak. Then, finishing the rest herself, she carefully cleaned the chick and carried away all remains of food and egg shell. Dismissing the attentive Tercel with a soft cackle, she nestled the little one into her warm breast and waited for its brothers to hatch.

In the course of the next three days the others broke through their glossy shells, and there was bustle and activity at the aerie in Forgotten Gully. In an ecstasy of parenthood Tercel cast his eyes upon the glen for food for his young; fresh meat that would give these scions of nobility the strength and vigor of their clan.

Below the waterfall a small gray bird darted after flies among the sun-drenched willows. For himself it would have been not worth a second glance; but now, relentlessly, the duck hawk plunged upon the unsuspecting phoebe. But he who condemns this killer should see the care with which he plucked and shredded the body for his babies on the cliff. Holding it tenderly above them, he stood with infinite patience while the nestlings picked the soft scraps from the powerful hooked beak.

As the youngsters doubled and trebled their size before two weeks had passed, they required increasing food. So the falcons ranged more widely, speeding down the valley to the inlet of the lake, where ducks were paddling about the piers and tumbledown boathouses. How would the duck hawks know that these were hand-fed fowl, raised to lure the wild ducks to the shallows for human killers to butcher? Both Tercel and his mate visited the inlet with increasing frequency, stooping audaciously before the very eyes of the irate owner of the ducks.

But man has many wiles, and in the minds of the peregrines, true sportsmen whose every move is fearless and direct, there arose no suspicion of a trap. It was Tercel who first encountered the hunched form of a great horned owl on the pier by the red boathouse. Furious at this brazen trespasser within his territory, in broad daylight, the duck hawk swerved from his intended victim. With an infuriated scream, "Cack-cack-cack-cack-cack," he plunged with lightning speed upon his enemy. As the great talons toppled the dummy owl to the ground a shot startled the ducks, but Tercel, sensing danger in the unresisting fall of the owl, had already veered and was high over the valley, empty handed but unscathed.

The peregrine's vocabulary, so rich in cadences of love and understanding about the aerie, so fierce and imposing in the face of danger, was inadequate to warn his mate of an insidious foe. Seeing his empty talons, Falco greeted him with a nasal, wailing note that faded musically on the air as she left him to care for the

young in her absence, while she sought needed food.

She winged her way unswervingly to the red boathouse in the inlet. The owl had been replanted, the gunner was ready. And this time his aim was true.

So Tercel was left alone with his little brood in the aerie of Forgotten Gully. Of necessity now, they must be left alone while he hunted, feverishly, as close as possible to the nest. Nothing was safe; the phoebe, widowed like himself, and the brood she had labored so to raise alone; the flickers in the old maple stub; the cliff swallows that had plastered their adobe nests to the overhanging rocks in a neat little colony. Only the hummingbird escaped notice, sipping nectar at a spray of columbine beside the very nest, and darting back upstream to the thimble of lichens and spider webs where her babies lay cradled.

When the immediate food supply became scarce, Tercel was forced to return to the meadows and fields of the valley. He shunned the inlet now, sensing an unseen danger, although he had never seen the beautiful Falco, nailed with outspread wings against the door of the ugly red boathouse.

Often he was away for long periods, but the fledglings were well feathered now and sturdy. The sparse natal down had long since been replaced by a thick, fuzzy coat of coarse gray, and that in turn was being pushed out by the brown-streaked feathers of the juvenal plumage. Long since, also, had gone the helpless mien. With fierce bright eyes the young birds now looked far out across the valley for their father, and met him at the rim of the nesting shelf, screaming and hopping wildly and quarreling for the front row. No longer need he stand patiently over their feeble heads and tear their food to tiny shreds. Frequently he passed the nest, as if to tantalize them with the sight of food, and when he did alight at last, they snatched the game and fought viciously for possession.

But trouble comes readily to young things left too much alone. It was a day in early June, when the fledglings were almost of age, that Tercel returned at twilight from a last futile hunt. As he nosed up the ravine his telescopic eye spotted a shadowy form alighting on his shelf! The horned owl, too, had young to feed, and Tercel had dallied a minute too long into the dusk.

Rending the air with his high-pitched screams of anger, the peregrine roared toward the cliff. If fleetingly there passed before his mind the image of that other owl in the inlet it did not stay the furious plunge of the anguished Tercel. At the waterfall he overtook the labored flight of the owl and crashed her to the rocks below. But with her fell the limp brown body of the youngest fledgling.

Thus three were left where four had been, and soon they, too, must leave the cliff where danger lurked in the shadows. They were near six weeks old, full-fledged, with brown-streaked pinions as long as those of their father, and muscles strengthened by constant waving and stretching. Yet still they stood on the rim of the rocky shelf, screaming at Tercel's approach.

Then came a day when he did not alight, but sailed past and circled around the amphitheater, calling alluringly, the clear high "aaaaaa" they had not heard since Falco had made her last flight down the hidden glen. Perhaps it was the call, perhaps the time was ripe, but as he passed the aerie again the eldest catapulted into the amphitheater and snatched the prize in mid-air. On swift strong wings, untrained except by the instinct born of the ages, she followed Tercel to a stub across the glen and ravenously devoured her first stoop.

The second fledgling followed that afternoon, but the third, smaller by several days and always the loser in the scrambles for food, remained screaming at the brink of the cliff, unfed through all that long day.

How different it might have been, had there been two to rear this hungry brood! When, next day, the elder sisters darted unhesitatingly into the air, they were ready to match their new-found strength against the first bird that crossed their path. But the weakling, further emaciated by his day of fasting, beat his wings helplessly upon the rim of the nest shelf.

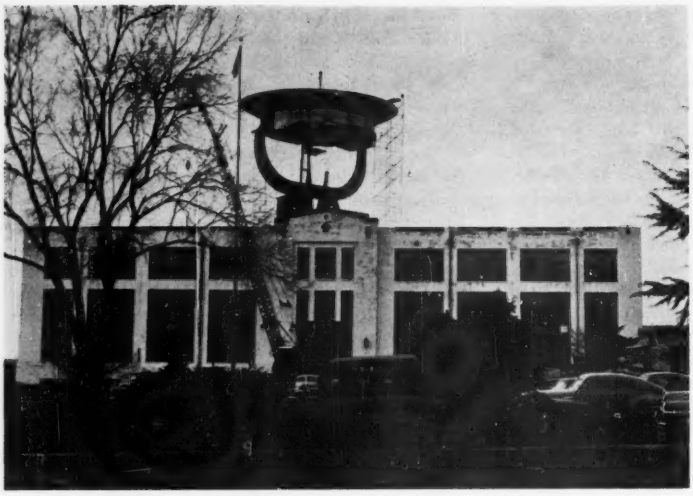
At his wailing protests Tercel approached with a small bird in his talons, and sailed tantalizingly past. Ruthless and inexorable, even toward his own flesh, he catered to no chick of his who would not earn his meat. Alas, poor orphaned waif who never had enough to eat to give him strength. In desperation he sprang out at last, but missed his prize, flapped madly to regain his balance, and toppled headlong upon the rocky floor of the glen.

Now two were left where four had been, for even to royalty disaster comes, sudden and unremitting. But these were falcons, brave and bold, who early learned to stoop and snatch the swallows that skimmed over the pool at the foot of the waterfall, and darted in and out of their nests on the face of the cliff. So swift and long of wing had the sisters become that either could have been mistaken for his mate.

But Tercel now was changing. No longer a bird of the year, brown-streaked above and buff below, he had attained adulthood with the cares of the summer. A dark gray mantle had spread over his back, deepening almost to black upon the crown. Beneath, the snow-white breast and flanks were barred with black. The black moustaches, ever bold, drooped sadly over the white cheeks.

For a time the family continued to roost at the old aerie, and hunted together up and down the valley under the skillful tutelage of Tercel, King of the Air. At length they ventured out over the marsh and beaches at the end of the Finger Lake. Killdeers were screaming over the muddy flats, ducks were paddling in the shallows, rising up in sudden panic as these bullets from the sky descended upon such easy prey. The young falcons grew strong and sure of themselves, restless as the days grew chill and dusk came earlier to the valley.

And then came an evening when the ducks circled high over the lake and set (Continued on page 442)



What appears to be a gargantuan chafing dish atop the Naval Research Laboratory in Washington, D.C. It will be used to study radio "signals" from the sun, moon and stars. It is hoped to extend man's knowledge of the universe and to put the new information to practical use in long-range weather forecasting and radio communication.

Giant "Ear" to Eavesdrop on "Invisible Stars"

By E. JOHN LONG

A RECENT addition to the Washington skyline is a strange apparatus that looks like a huge chafing dish.

"What's cooking?" I asked scientists at the Naval Research Laboratory, above whose three-story headquarters the weird device soars more than fifty feet.

"Galactic radiations!" one of them replied, with a grin.

I thought I knew a little about a lot of different sciences, but they had me! When I promised to be less flip, they explained that the "dish" is part of the Navy's latest effort to unlock one of the strangest secrets of outer space.

The Navy has an interest in the skies that is second only to that in water, its traditional element. Stars were the earliest navigational aids, and are still one of the most reliable. And then there is the U.S. Naval Observatory in Washington, from which this country, and a good part of the world, gets its official time.

But your modern scientist, including those in the service of the Navy, are aware that there is more than meets the eye in the vast unmeasured realms beyond our solar system. "Signals" that we cannot see, called galactic radiations, are given off by the sun, moon, stars and "invisible stars." The latter, while they also cannot be seen, are known to exist and to retain fixed positions.

In 1946, the Naval Research Laboratory launched a program of radio-astronomy, to extend the range of astronomical observations, and to try to clear up a few mysteries that might have bearing on celestial navigation, long-range weather forecasting, radio communications, and, possibly, interplanetary travel.

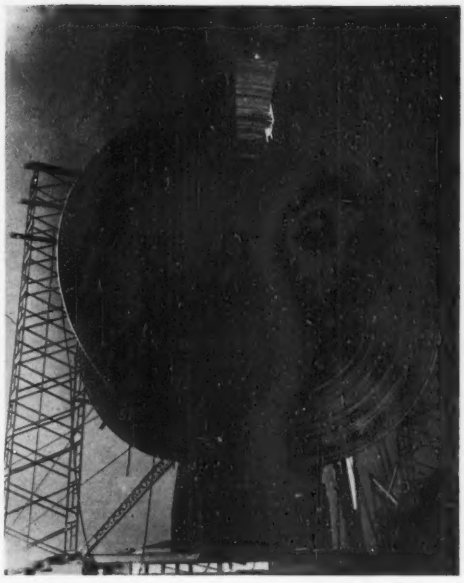
Scientists, for instance, have known that, although energy is being continually emitted from the sun and stars, the earth's atmosphere is "opaque" to most of it except for two "windows." One of these is in the visual range of the spectrum — those wave lengths which the eye can see. The other "window" is in the short wave-lengths, or micro-wave radio range — a band from several tiny millimeters to thirty meters.

Classical astronomy, using the telescope, can study only those radiations from outer space in the first "window," the visible portion. But this part of the spectrum is small indeed. In fact, its range is so limited in comparison to the complete spectrum that we must resort to mathematics to express it — from about 0.00003 to 0.001 centimeters, an infinitesimal span.

Here is where the vast *new* realm of radio astronomy takes over, opening the second "window." Just as a telescope uses a concave optical mirror, the "radio telescope" makes use of a large, concave, metal reflector and a radio receiving antenna. The reflector has to be larger, because radio wave-lengths are longer than those of visible light.

As an astronomer employs an eyepiece, the radio astronomer "looks" at or detects (he really listens) the

The last section of the "radio telescope" being lowered into place. This instrument was designed by the Naval Research Laboratory, and constructed by the Collins Radio Company, Cedar Rapids, Iowa. In addition to the program at the Naval Research Laboratory, radio-astronomy using micro-waves is being conducted at the National Bureau of Standards and at Cornell University, the latter under Office of Naval Research contract.



radiations with an extremely sensitive radio receiver. The radiations obtained in this way are recorded in visible form, however, on a moving strip of paper.

Radio astronomers have a problem not faced by ordinary astronomers. The longer wave lengths of radio astronomy make it difficult to distinguish between two sources of radiation approaching from nearly the same direction. At the Naval Research Laboratory this has been attacked by using a larger diameter reflector and choosing shorter radio wave-lengths.

Hence the big "dish" on the laboratory roof. Technically it should be described as a fifty-foot diameter, high-resolution, paraboloidal reflector, capable of using three wave-lengths — three, ten, and thirty centimeters.

The big reflector itself is mounted in a heavy steel frame atop one of the Navy's steel five-inch gun mounts, the latter like those on a destroyer. The inside of the disk consists of thirty aluminum sections, bolted together to form a smooth, solid surface.

A gun mount, of the type designed for dual purpose ship rifles during World War II, proved ideal because it could be rotated a full circle in the horizontal plane. Also, it can be moved vertically from below the horizon to five degrees beyond the zenith. An axis converter corrects for the inclination of the earth's axis, and permits the "dish" automatically to track or follow the sun in its path across the sky, a path which, of course, changes from day to day.

The new radio telescope can be controlled manually, or it can be connected to a five-inch astronomical telescope by remote control. If desired, the system can be operated manually at the reflector mount itself.

In addition to studies having a practical aspect, such as radio communications, navigation and weather forecasting, the program of radio astronomy projected by the Laboratory incudes use of the "dish" also to fathom those mysterious patches in space called "hot spots."

More than fifty of these "spots" now are known. They are also called "radio stars," and, although they are completely invisible, they are reported to be many times bigger than the largest stars. Another strange aspect — they hold their positions, and therefore cannot be comets or other known phenomena.

Sun spots and "hydrogen flares" may also be investigated more completely with the new apparatus.

Despite my promise, I could not resist a topical question.

"What about 'Flying Saucers'? Will the 'dish' be able to spot 'em?" I asked.

"No, they are not in our department," was the reply, "but we can predict, if Washington is ever hit with a 150-mile-per-hour wind, the dish may break loose and itself become the biggest flying saucer on record."

Overall weight of the installation is seventy-five tons, of which the "dish" weighs fourteen tons and the gun mount about twenty-seven tons. The rest is frame and fittings. While a number of tests of the equipment have already taken place, the planned program awaits the completion of radio receiving equipment.

In mid-May, 1951, when the sun had another of its sun spot tantrums and played merry hob with earthly communications, several tests were run on the "dish." What the Navy scientists "heard," and what the significance of it may be, was not revealed.

If you like "continued stories," however, the most fascinating of all time has been going on for quite a spell just beyond that twenty-mile envelope of atmosphere, which lies between us and the boundless limits of outer space. Navy scientists cannot guarantee anything, but that they may "dish" up a new chapter or two with their new radio telescope, perhaps throwing real light on "invisible stars," one of the hot spots of creation that has remained almost a total mystery.

Feminine Gender

By LOUISE MAYERS MEREDITH

A *us* Latin noun should be
The sign of masculinity;
But gladiol*us* is a mother:
Her blossoms follow one another.

Interior of giant ice cave on the ranch of David Candelaria, southwest of Grants, New Mexico. The solid layer of ice varies between eight and fourteen feet in thickness and is never known to melt.

"Ice Boxes" of the Desert

By NELL MURBARGER

THAT some of the hottest, most arid sections of the desert Southwest should contain huge caves packed with solid ice of unknown age and depth, is one of Nature's strangest anomalies.

While the most noted ice caves are those of Modoc lava beds in northeastern California, and those near Sunset volcanic crater in northern Arizona, another important group is situated near the base of Bandera crater in Valencia county, New Mexico. Only partially explored, and until recent years difficult of access, the latter group of caves is virtually unknown.

Regardless of location, all these refrigerated caverns are basically similar. Also, the fact that all are restricted to areas deeply blanketed beneath ancient lava flows, explains in part the actual conditions.

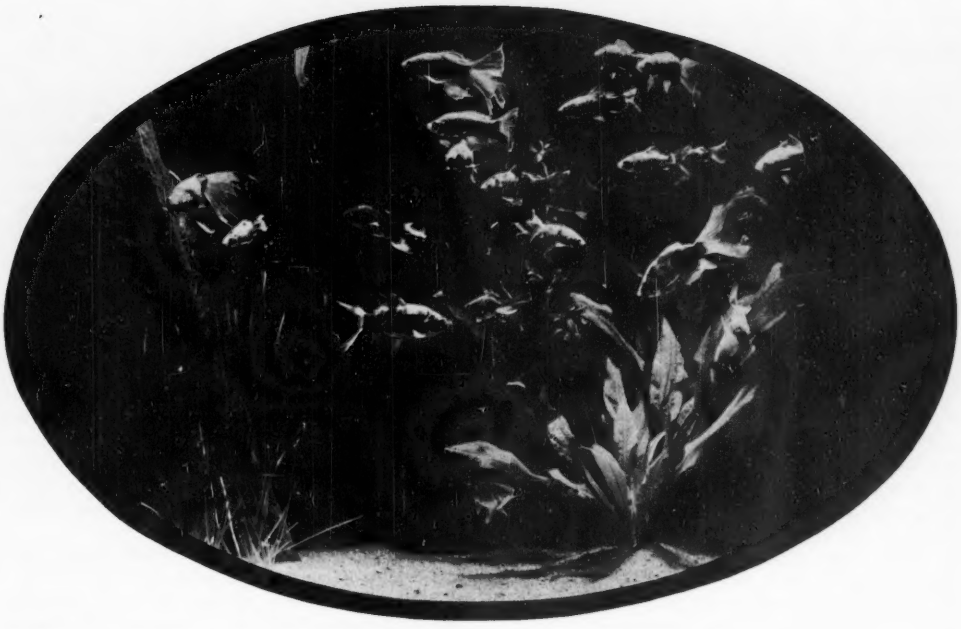
During some long ago, turbulent age, geologists tell us, a mighty tide of molten lava engulfed the land. Contact with the air cooled the surface, while the center remained hot. As the molten part drained away, the hard surface crust remained. The result was a series of chambers ranging from tiny pockets to great vaulted halls.

Not so easily determined is the reason that a few of these underground pockets came to be filled with seemingly perpetual ice.

In the largest of several known caverns on the Candelaria Ranch, near Bandera crater, the ice deposit has assumed an aquamarine color and shows dark, horizontal stripes. Although openly exposed to the air and less than twenty feet below the surface of the lava-encrusted earth, the cave's contents have never been known to melt, even during the scorching days of midsummer. In addition to a floor of solid ice, extending downward to unknown depths, the cavern has a great backwall of ice, fifty feet wide and from eight to fourteen feet in height. It is also not known how far this icy river may extend beneath the plain.

Neither does anyone know how long the cold, blue wall may have stood intact. Earliest white settlers in the region have left records of chipping great loads of ice from it, using the ice for refrigeration and as a source of water in this arid land, where surface flows are virtually non-existent. As the ice constantly replaces itself, it is possible to go back still farther and presume that it was likewise employed by prehistoric tribesmen who inhabited the region over a long period of time and in considerable numbers.

From several small habitation caves nearby, archeologists have recovered a remarkable assortment of Indian artifacts, the workmanship and design of which places their manufacture around 1100 A.D., according to Dr. H. P. Mera of the New Mexico Laboratory of Anthropology. Use of the caves as a water source for mankind thus may extend back close to 1000 years, while desert animals may have been served for countless centuries before the coming of primitive man.



The Rise and Fall of An Aristocrat

By IDA M. MELLEN

Photograph from New York Zoological Society

Its beginnings were humble, for the fantastic shapes and glorious colors of the cultivated goldfish had their origin in plain, Chinese, blue-brown carp. Always, if artificial selection were discontinued, the goldfish, although the product of centuries of cultivation, reverted to its original type. Even in the home aquarium the colors might change, and we hear of people who boarded their goldfishes for the summer and refused to take them back in the fall because of their unrecognizable change of color.

Under domestication, in the earliest days, the wild color gradually changed to black in the first year, then silvery, and finally to the vivid ruddy gold that makes the fish so alluring in the aquarium or the garden pool.

Beginning in the 7th century in China, carp that showed tinges of gold were carefully chosen for special breeding and fixation of the golden hue, and various breeds of goldfishes were evolved. From China they reached Japan in the 16th century. There artificial selection was also practised and more new breeds produced. Taken to England in 1611, goldfishes were later adapted to brackish water in Bermuda, and finally arrived in the United States in the 19th century, where they reached their maximum popularity in the early years of the 20th century, essentials in many homes.

The goldfish spawns several times in a season, from March to July, or May to September, at a temperature of 59 degrees, and is so highly prolific that, at two years, it may lay 2000 eggs; at three years 25,000; at four or five years 70,000. In a temperature of from 60 to 70 degrees, the eggs hatch within a week; in a longer time if the water is cooler. Moreover, goldfishes are known to live for twenty-five years, their dimensions being governed by the amount of swimming space afforded them. In the home aquarium, with its limited freedom, they may never become longer than six inches, but if allowed the area of a lake or pond, they commonly attain a length of two feet.

The straight-tailed goldfishes have long been the most popular for the ornamental pool. For the home aquarium, both these and the fancy breeds have found favor. All goldfishes are of only one genus and species, *Carassius auratus*. Among the fancy breeds, more common in the 1920s and early 1930s than now, are the comets, with long, forked tails; the telescopes with bulging eyes, which include the calico telescopes that resemble the dark, rich coloring of a Paisley shawl; the Chinese Moors or black telescopes; veiltails; fringe-

tails; Japanese nymph, produced by crossing the comet with the fringetail; celestials, with eyes that look only upward; lionheads, with hoodlike protuberances on the head and no dorsal fin; orandas, representing crosses between fringetails and lionheads and resembling the latter except for a longer tail and the presence of a dorsal fin; the Shubunkins, which are calicoes with normal eyes.

Some of these rare breeds brought fabulous prices in both Europe and America. In 1925 a New York fancier refused an offer of $1000 for four fine lionheads. In 1929 a blue telescope, veiltail goldfish, exhibited at an aquarists' show in London, was sold for $500.

By 1928 more than seventeen million straight-tailed goldfishes per annum were being reared in the United States for the home aquarium, together with about four and one-half million of the fancy breeds. By 1934 about six million per annum were imported from Japan.

Then came the "toy tropical" — the guppy, the swordtail, the moonfish, the barb, the fighting fish, the rubra, the cichlid, and a dozen other species of pigmies that slowly but surely replaced the goldfish in popularity, however beautiful or odd the latter might be. Today many of the former goldfish farms are devoted to rearing the toy tropicals, aquatic plants, and small animals and plants for the terrarium; and some engage in rearing bait fishes of various species.

A price of $100 could hardly be realized now for the choicest specimen of goldfish in the country, nor would it be easy to find some of the fancier breeds. But about ten million straight-tailed goldfishes are still reared annually for our home aquariums, and in spite of all that has been written concerning their needs, millions are still martyrs to the loathsome bowl with its insufficient oxygen and swimming space.

The goldfish has now entered upon a new role, or, rather, two new roles. It has spawned so profusely in lakes and ponds that in the Tennessee Valley enormous hauls of small ones are made to serve as bait. In large lakes, however, it mates with the carp and grows large and indistinguishable from carps except for the absence of barbels and for a remaining tint of gold. In recent Government's fishery statistics one notes a surprising, not to say startling, line in the report on Lake Fisheries. It reads: "Goldfish—54,900 pounds-value $3000."

On reading this, one who has ever been a goldfish "fan" involuntarily asks, "What can that mean?" It means that 53,400 pounds were taken in Ohio in that year for food, and 1500 pounds in Michigan. Those taken in Michigan were sold locally, principally to Negroes, who enjoy the flavor of the golden carp. Those taken in Ohio were shipped to eastern markets, some coming alive, like carps, for the Jewish trade, others packed in ice to suit the Chinese taste.

The goldfish, therefore, although still featuring in considerable numbers in the home aquarium, serves also as bait and as food. Having risen from plain wild carp to the gorgeously colored and fancifully shaped aristocrat of the home aquarium, and having enjoyed its moment as the most valuable ornamental fish in the world, the goldfish may one day find itself chiefly valued for the seine or as an item for the dinner platter.

Bunchberries Unlimited

By EDWIN F. STEFFEK

LIKE a carpet of dogwood blooms fallen to the forest floor — that is the dwarf bunchberry in bloom. Unfortunately, however, this is a sight no longer common, due to advancing "civilization" and indiscriminate picking. As with other plants that grow from creeping underground stems, an attempt to pick one flower often results in a long line of plants torn up.

However, this miniature relative of the treelike dogwood is not difficult to increase, and, with a little effort, one can readily produce enough plants to get it started in a sanctuary or wild garden. The important thing to remember is that it needs a cool, acid, woodsy soil with a moderate but continuous supply of moisture. Partial shade, too, is desirable for best results. The flowers are small and surrounded by four white bracts, spotless and on dainty stems about four inches high, and framed against a background of deeply-veined leaves. They appear in late spring, or early summer in the mountains, and are followed by attractive clusters of shining scarlet berries.

Plants may be successfully propagated from seed. As soon as the berries are ripe in late summer or fall, free the seeds from the pulp and plant in sandy, acid leafmold in boxes or the open soil outdoors. Keep reasonably moist and growth should start the first spring. Flowering usually commences the third year. Plants may be dug in late summer, divided carefully, potted and kept in a cold frame for spring planting.

Adventures with Viceroys

By EDNA PECK ATWOOD

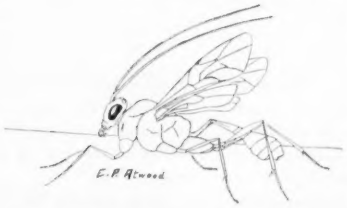
Illustrated by the Author

"The late Viceroy's full-dress uniform, greatly shrunken, was draped down one side of the cocoon like a carelessly worn neck piece..."

TODAY we would call it a gulch or ravine. The pioneers called it first Joshua's Gulf, then Stephens Gulf, after Joshua Stephens, who was killed there by Indians as he searched for strayed oxen. Except for an improved road, the gulf is as wild as ever. It is a place of trees, bushes, wild flowers, ferns, and mosses in variety, also a place of birds, rocks, and perpetual water-song.

Driving through its secluded reaches of sun and shadow, we stopped to get yellow birch foliage for a big Polyphemus-moth-larva back home. Doing so, we almost brushed against two horny, warty, brown larvae with white saddles — Viceroys. A butterfly (or moth) exists in four forms — egg, larva or caterpillar, chrysalis or pupa, and adult with wings. Just as growing children continually need larger clothes, caterpillars have to have new outfits. They grow their own and in the process molt five times. Then they are chrysalids. I judged that these "cats" had already molted three times. It takes quite a while for a "cat" to grow up. All the time he is exposed to more dangers than many people dream.

There are many kinds of parasitic insects that lay an egg, or eggs, on or in the bodies of the cats. These eggs hatch into tiny larvae that feed inside the victim, always sparing the vital organs lest the creature die before they are fully grown. Usually they emerge and spin cocoons, each in his family fashion. But all species do not follow the same rule, for some wait until another springtime and emerge from the prey's chrysalis, in his stead. Oddly enough, a species of parasite generally confines himself to a single species of prey. If he destroys them all, he dooms himself.



Ichneumon, enemy of the Viceroy. Enlarged four times in the drawing. Below, the caterpillar is starting the hibernaculum.

The most numerous parasites are the ichneumons, the braconids, and the tachinas. If a caterpillar survives these enemies, he still must escape the notice of birds, predatory wasps, and others. He lives dangerously. But, had he no enemies, he would overrun the earth. There have to be checks.

Now let us return to the cats of Stephens Gulf. Their host plant was poplar. One caterpillar was smaller than the other, although they were doubtless of the same age. The smaller cat clung to what remained of a leaf tip — its midrib. The larger one held a station on a nearby leaf. To collect them was a mere matter of severing their twig and adding it to the birch, kept fresh in water brought along for such purpose. Soon they were transferred from the watershed of the Canisteo to that of the Conhocton, both headwaters of the Susquehanna.

Next morning the poplar was wilted. Knowing most cats to be in a rut about food, I set out for fresh poplar. After a half-hour's absence, I found the lesser Viceroy no longer in need of food. He was the victim of a parasitic assassin, and, of course, had been parasitized long before I adopted him. This also accounted for his lesser size. Now the horrid, legless, waxy-white larva of the parasite, resembling the larva of a wasp, had neatly split down the middle of the Viceroy's tummy and emerged. He was losing no time in making a cocoon. Had I been away much longer, the villain would have been concealed. Completed, his cocoon was capsule-shaped. It had spaced, irregular, black markings, his family label, doubtless.

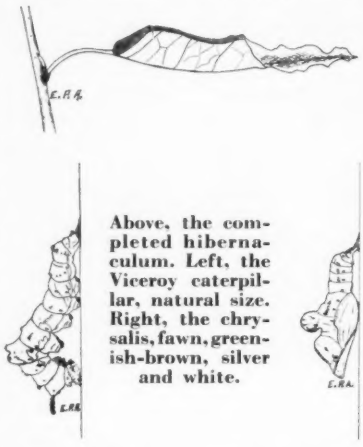
The late Viceroy's full-dress uniform, greatly shrunken, was draped down one side of the cocoon like a carelessly worn neck piece, orthodox in every way — head, feet, and tail attached. Somehow it was a more gruesome trophy than its scarf prototype. I studied it sourly and knew here was indeed a new way to skin a cat(erpillar).

My hopes were now pinned on the other Viceroy cat. Would he prove to be parasitized too? Maybe. I began to sketch him before Nature's legerdemain turned him into another form. He was as warty as a horned toad and so difficult a subject that all spare time for two days was needed to depict the last beautiful wart. That was partly because he was so small — only five-eighths of an inch long. Endless squinting through a strong lens was necessary. He should have been flattered by so much attention.

Before the sketch was finished, the Viceroy carpeted his leaf with silk. As often as he turned, he silked the

leaf petiole to the twig. Caterpillars do that when they prepare winter quarters. It prevents the leaf from falling. This fellow ate considerable quantities of the leaf, too, making deep inroads into it. Later it was evident that he tailored the leaf to fit him. During the night he gnawed off most of the sides and the tip. It was a deliberate and calculated discard. The fragments lay where they had fallen. Morning found him drawing the remainder of the leaf up about him and silking the edges together. This was to be a silk-lined sleeping-bag and the task was well along. Growing famished, he went to the leaf next above him, ate his fill, and returned to work on the hibernaculum, the name entomologists invented for this type of winter resort.

In twenty-four hours the caterpillar's tube was as long as he was. He retired into it between meals. His tail was the door. He had an adequate doorstep for easy entry and exit. On September 1, he narrowed the doorstep a bit. He would have nothing superfluous. He left his home less and less often for food and exercise. Finally I did not see him come out at all. It seemed early for wintering in, but still it was too late in the season for a half-grown Viceroy to complete his life cycle with added time for progeny to reach the same stage — the stage of wintering. Insects abide by family law or the race perishes. Grievous to relate, this cat perished anyway. One day I went to look at him and found him backed out on his doorstep and quite dead. His forebody was rounded and stretched as if containing a capsule-shaped object; his rearbody was shriveled. I put the corpse and the hibernaculum into a covered glass jar. If the forebody held the pupa of an unidentified parasite, perhaps a tachina fly, it never hatched, either then or in the spring.



Above, the completed hibernaculum. Left, the Viceroy caterpillar, natural size. Right, the chrysalis, fawn, greenish-brown, silver and white.

But the capsule-shaped cocoon made by the assassin of the first Viceroy cat did hatch. When it was eight days old, on September 4, a quarter-inch ichneumon fly came from its lower end. The ichneumon looked longer because its antennae doubled the span. It had orange legs and a tan to reddish-brown abdomen. Head, thorax, and antennae were black. Its four, transparent, iridescent wings could be folded flat on its back. Its antennae waved constantly as it promenaded inside its glass jail. It had itching feet and legs, and, as there were six of them, they took a deal of rubbing. The little parasite had no visible ovipositor, or egg-laying organ. It resembled a wasp and it wiggled too much to be anythng but an exasperating model. I struggled with an outline and filled in details after its uneasy, thwarted life ended.

Meanwhile, on September 8, I went hiking, and, this time on willow, found a fully grown Viceroy cat. At once I understood why his predecessor had hibernated in his particular stage of growth. Had he waited to grow such grotesque humps and horns as this one possessed along with his final skin, he could neither have entered nor left the straight, snug-fitting tube that winter-quarters must be. Yes, Nature's laws are founded on good sense, even though we have not always enough of our own to see it without proof. Another example of the ultimate in foresight had been the twisting of the stem of the hibernaculum-leaf so that the little nest would be bottom-side-up and always dry inside, no matter what the weather. And what deep mystery surrounds the hibernaculum, anyway! The impulse to build one appears only in alternate generations and sometimes less often, for Viceroys have two, or sometimes three, broods a summer and only the last brood builds. Comprehension fails.

All these thoughts were mine as I carried the new Viceroy cat home and put him in a screened box with willow twigs. However, he had no mind for anything but travel. He was indeed mature and had the customary wanderlust. Next morning he was hung by the tail near the upper rim of his quarters. He had no sling such as swallow-tails use for added security and he could not have passed his horns through a sling anyway. Head down, he awaited transformation. That day's job was doing his portrait. The next night the hung Viceroy shed his skin and became a chrysalis — a very odd one with a hump or boss on his back; another picture for copying.

After drawing for hours, I found that the chrysalis had not become rigid. It was capable of considerable movement and was apt to hatch in a few days. Nature was decreeing that this much older Viceroy had a chance to further race survival to the hibernation stage.

And so it proved. After eight days the chrysalis hatched. That was an event. Usually one finds the butterfly too late to watch development. The hour was 6:30 A.M. I chanced to see the chrysalis widen, due to split. The Viceroy pushed out slowly. Once out, he made a quick turn and hung by his feet to the empty chrysalis. He was right side up again. He was a four-legged butterfly, so-called because only two pairs of his legs were useable. His first pair of legs was dwarfed and folded against his breast. The butterfly swayed his body from side to side. Gradually his crumpled wings expanded. They contacted the box and he at once evaded it by change of position. When first hatched, his proboscis was plainly two coiling tongues. Presently they united as he manipulated them, while I watched fascinated by what went on.

His wings developed fully in seventeen minutes, but required more time to stiffen. By nine o'clock he was fanning them and parading on the back of my hand and up my arm. The entire back of his body was like black plush. White decorations on his sides added much chic to his attire. His wing color was reddish-brown to brownish-orange, with black veins and black and white borders that became quite deep at the forewing tips. He was beautiful. The casual observer might mistake him for the better known, larger, Monarch butterfly. But the Viceroy is a pretender, a mimic. He profits by mimicry; for the Monarch has an evil taste, disliked by birds. Thus the Viceroy is less subject to their attack, because he is judged to be just another dark brown taste.

The Viceroy emerges and hangs in an awkward pose from the chrysalis.

Really a Viceroy butterfly is readily distinguished from a Monarch —aside from lesser size — by the black arc that crosses his hind-wing veins. But it is odd that two butterflies should look so much alike when their larvae are so different.

Meanwhile my Viceroy was climbing and would have had all fours in my neck had I not interposed a finger and induced him to mount it. His tongue investigated the finger and I put a drop of syrup before him. Soon he tasted it and began to breakfast. His antennae bore news of the food. Once he moved from the syrup area and lost it. His antennae were used to find it again, but not by touch. Apparently they had organs of smell. With hunger satisfied, the Viceroy resumed his climbing. He first tested his wings in flight at 9:23 and I freed him at 11:00 A.M., on September 18, with a benediction and a wish that the fall be long and mild

The annals of that year's Viceroys were ended for me, but not the annals of the parasites Another species, braconids this time, doomed the Polyphemus, whose need for yellow birch had gotten me my first Viceroy cats. About 200 of their tiny larvae made a living sieve of poor Polly's skin as they emerged to spin their neat little cocoons. What an end to an otherwise perfect day!

Surely it would be easier to make biographies of parasites than to complete the life story of a butterfly or great moth, so often ill-fated. I was cloaked in the same gloom that plagued Malthus of old, although he thought of human population. However, we thrive in teeming millions after 150 years, and perhaps the butterflies will survive, too.

I took my upset serenity out into the garden after grapes for my supper and zinnias for my soul. As is usual the appetite got priority and the grapes were gathered first. As I neared the flowers, something hopped from zinnia top to zinnia top. I drew nearer by stealth. *Hyla crucifer*, an exquisite little tree frog, sat erect in the middle of a leaf like a wee monkey in the tree tops. I approved his delicate chameleon-colors, diamond-patterned back, and the steady, rhythmic pulsing of his pliant throat. I looked into his speculative, appraising eyes, so bright and full of life, and I backed slowly away. No longer did I need zinnias for my soul. My world was plumb again, made so by a sly, fairy piper that shared it with me.

★

Black-Capped Chickadee

By FRANK DAVID HARRIS

My grandpa wore a skullcap, too;
But Grandpa was a sage.
I always knew
Such caps were meant
For heads bowed down with age.

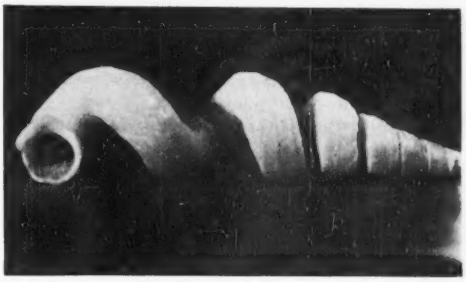
One minute you are right-side up;
The next, you're upside-down;
Your acts are not a bit sedate:
You caper like a clown!

It's inappropriate, I say,
For you to wear that hat
And be so gay!
I never saw
My Grandpa act like that!

★

Shell in Spiral

By GLENN R. DOWNING



ONE could easily mistake this remarkable shell for some sort of worm. Beginning in rather close whorls, the shell elongates, and often veers off in a different direction in some specimens. It belongs to an animal called *Vermicularia spirata*, which has an elongated viscera and a short, broad foot, and is a true gastropod mollusk, although the inhabitant of the shell looks more like a worm, and has a snail-like tongue. It is brownish in color with black spots, while its shell is a yellowish-brown in color. It is often found grouped together in Atlantic coastal waters, and is also to be found in the waters of the Gulf of Mexico.

Flower Toys and Garden Pastimes

By ROBERT C. BAUR

Illustrations by William H. Bodge

WHAT fonder memories of childhood could one have, than those happy summer days that passed so swiftly in a garden? Larkspur, phlox and hollyhock were more than plants to delight the senses; they were friends with whom to share each sunny hour. Colonial children found the garden a place of enchantment, for, despite the sober habits and dress of their owners, Puritan gardens bloomed with all the pomp and color of old England. There, the imaginative child could turn seed pods and flower cups into clever playthings that provided the same pleasure as the store-bought toys of today. Handed down through many generations, the origin of these flower toys is unknown, although it is believed that many date back to medieval times.

The dandelion has the distinction of being the first flower that the average child learns to name. Gardeners might term this European immigrant a pest, but its golden flowers have endeared themselves to children everywhere. Such wonderful wampum beads could be strung from the unopened flower buds, and the blossoms were plentiful enough to fill a doll's cradle with downy softness.

At a loss for something to do on a warm May afternoon, we picked a mess of dandelion blossoms and boiled them with sugar and lemon into a concoction we called wine. Far from intoxicating, connoisseurs will disagree with our formula, but we thought it delicious, drinking the sweet juice before it had cooled. Once we bottled the surplus and hid it away in the old stone wall. I wonder if the chipmunks are guarding the treasure after all these years?

Even in old age, the dandelion contributed to childish pleasures. Almost any question could be answered by the number of seeds left after blowing on the hoary seed-head. A frequent query was, "How many children will I have?" The hollow stems were drinking straws through which soap bubbles could be blown. Placed in the mouth, the ends retracted into lovely gray-green curls.

Fairly bursting with April and childish laughter, is the verse about the daffodil, which crossed the Atlantic with our ancestors.

Daffy-down-dilly has come to town,
In a green petticoat and a golden gown.

Another golden flower is the butter cup and who has not touched a pollen-laden blossom to a playmate's chin to determine whether or not he liked butter?

Children have always delighted in gathering wild flowers, a practice as wasteful as it is well-meaning. However, the old New England custom of hanging baskets of spring beauties and violets upon the doorknob of a friend on May Day is a pleasant one. Jack-

in-the-pulpit was a favorite, for "Jack" could be twisted into preaching a squeaky sermon.

Pressing flowers was a pastime especially designed for young ladies, who preserved their specimens in the back of the ponderous family Bible. Many of these ancient volumes of scripture have been passed down to us, their pages yellowed with tattered forget-me-nots and adders-tongue. Festoons of larkspur often decorated the title pages of books, forming wreaths around the owner's name. These wreaths were sometimes glued to paper and sent to loved ones as valentines.

History makes no mention of the numerous violet wars that took place each spring, when armies of violets were drafted into combat as soldiers or fighting cocks. The gladiators' heads were interlocked, and little fists clutched the stems and pulled until one or the other violet lost its head. Soon the battlefield was strewn with the heads of the vanquished. Sometimes the combatants were so evenly matched that they lost their heads at the same time. Then again, a warrior would be victorious over many battles, retaining his head

until peace was restored to the garden once more.

The bleeding-heart or lady's-ear-drops, held a prominent place in the old-fashioned garden. Symbol of love and wounded hearts, it was believed that a lover's heart was true if red juice appeared after the flower was crushed. The graceful racemes of pink, heart-shaped flowers were bags full of fairylike toys. Resembling a hoop skirt with the pantaloons showing, the blossom could be dissected to reveal a valentine. Childish imagination also devised a pair of browsing rabbits, ladies' slippers, and a harp and bottle.

No spring garden was complete without the smiling presence of pansies, and the esteem in which the tiny plant was held is best described by the number of names bestowed upon it. "Hearts-ease," "herb-trinity," "forget-me-not," "faces-under-a-hood," "little-step-mother," and "birds-eye," are a few of them. Children having no other playmates could share their secrets with the pansies, who never told, regardless of what was intrusted to them. Some children even claimed that pansies talked back to them. Papoose-like pansy dolls were made by wrapping leaves or bits of cloth around a pansy blossom.

Three I love I say,
Four I love with all my heart,
Five I cast away.

Daisy grandmothers were made by inking faces on daisies and clipping the petals to look like the ruffled night caps worn by elderly ladies of the time, the chin straps being provided by two uncut petals.

An old wooden trunk sold at a recent Connecticut auction, contained a curious assortment of dried acorns and rose hips, which proved to be a home-made tea set that had outlived its little owner by half a century. How proudly this forgotten child had served her guests with her rose hip cups and their acorn cup saucers. Bent pins served as nicely as handles on the frailest china.

The little hostess found the garden a larder of dainty morsels with which to spread the tea table. There were hollyhock cheeses, daisy pies, and pumpkin and sunflower seeds on which to nibble, not to mention gooseberries and juicy strawberries in season. "Rosy-cakes" were made by placing rose petals between strips of paper and sprinkling them with cinnamon and powdered sugar. Pressed beneath a rock and left overnight, the

Brought to America in sacks of grain, the ox-eye daisy drifted like snow across the meadows, providing material for many flower games. Solomon in all his glory was not arrayed so splendidly as a pink-cheeked girl, garlanded with daisy chains. Strung into necklaces and crowns, daisies rival the rarest of gems, and they decorated the bridal veils of many a make-believe wedding.

While modern maids rely upon their compacts and lipsticks to assure them of a husband, the old-fashioned girl retired to a hillside pasture to ask the daisy if she occupied the number one position in her beloved's heart. As a medium of divining the affections of another, daisy petals were plucked while saying: "He loves me, he loves me not," until the statement was confirmed by the remaining petal. Of course if the daisy gave an unsatisfactory reply, the process could be repeated until the intended's love was assured. Daisy petals were also plucked to the old apple seed rhyme.

One I love,
Two I love,

cakes were crisp and wafer thin by morning. Oxalis leaves and grape tendrils added something sour to the feast, and for dessert there was the sticky gum scraped from the bark of a plum tree, and nectar from columbine and honeysuckle. Poppy pericarps made ideal pepper boxes which dispensed the tiny, black, seed-like ground pepper.

Colonial children made chewing gum by breaking milkweed stalks and letting the sap harden in the sun. The flavor did not equal that which comes in the nickel package, but the gum could be chewed until jaws became tired.

The tiny wooden dolls, popular some years ago, were decked in creations of unequaled color and design, for milady had the entire garden for her milliner. Exquisitely gowned, dancing puppets were made from blossoms of the oriental poppy, the double balsam and the hollyhock.

Congregations of colorful ladies were assembled by sticking pins in blocks of wood and covering them with flower cups, which swayed in the breeze like waltzing

hoop skirts. One little girl, forbidden to play with dolls on the solemn New England Sabbath, was permitted to while away the tedious afternoon, amusing herself with these flower dolls. However, the game ended, all too soon, when it was discovered, to the horror of her elders, that she had defiled the holy day by arranging her flower ladies in quadrilles and was playing dancing party.

A boy is not a boy unless he makes noise, and, even in the quiet beauty of the garden, boys found ways of producing sound effects. As long as there were blossoms and leaves to explode, the boys were happy. They took a fiendish delight in blasting upon strips of ribbon grass, or blowing up Canterbury bells and morning glory trumpets. Still louder pops were made by placing broad leaves on the extended thumb and forefinger of one hand and striking them with the other, a practice still enjoyed by the "small fry."

A garden full of balloon-flowers was the small boy's dream, for the unopened buds made such a pleasing pop when squeezed. Foxglove fingers were also popped, a custom so widespread that the plant was known as "frog plant," "blow leaf," and "pudding bag plant." To many English children, the foxglove was referred to as a "pop."

Noisy squawks were made from birch barks, and it seemed that every village had an "old timer" who endeared himself to the younger generation by the piercing quality of his willow whistles.

Trapping bees in flower cups was an exciting sport, having all the dangers of big game hunting. The unsuspecting insect was captured by pinching the ends of the blossom together. An angry buzzing followed, until the bee escaped through the side of the flower. An occasional howl of pain, announced that the bee had found its revenge. If purple hearts were awarded to these bee stung veterans, the greater part of our male population would be heroes.

Brought from Europe to shade our streets, the horse-chestnut was by far the small boy's favorite tree. Rivalry was keen over who gathered the biggest sack full of chestnuts, and many an attic has yielded moldering hoards of these treasures. Besides hoarding them like misers, the boy with a jack-knife could turn a chestnut into a tiny basket or delicately carved brooch. Populations of grotesque little horse-chestnut men were dressed up with comical faces and hats of paper. The rounder chestnuts served as marbles, and could be used in many games. Cob nut was an old Colonial game played with chestnuts, and two chestnuts tied to the ends of a yard of string could, after much practice, be skillfully twirled in opposite directions.

The boys scoffed at the blonde and brunette coiffures their sisters fashioned from corn silk, preferring to smoke the stuff with sweet fern in their cob pipes. Often as not, smoke detected behind the back fence resulted in a trip to the woodshed for the culprits involved.

Inscribing pumpkins with weird faces and Indian symbols meant exciting moonlight excursions intended only for the adventuresome. Came the dawn, it looked as if spirits had left their mark upon the fruited vine, which set the irate farmer to patrolling his corn-field with hound and shotgun. Selecting the largest pumpkin for a jack-o-lantern was a tricky job, as the pumpkin had to be carried off under cover of darkness. It was customary to frighten the farmer, from whom the pumpkin had been spirited, by raising it upon a pole outside his kitchen window, the vegetable transformed by candle-light into a hideous grinning monster.

Apple wars raged among the neighborhood boys as long as the windfalls held out. One never knew when or where the attack would come. An errand to the spring house might result in ambush and the cautious lad secreted caches of apples for just such an emergency. Hard Baldwins and russets projected on pointed sticks were best for long range bombardments, making a fearful racket as they crashed through the foliage. Rotten MacIntoshes were reserved for close combat and special enemies.

The last peal of thunder had scarcely rolled away, before barefoot boys were scampering over the sodden lawn, delightfully cool after the scorching heat of the day. Raging torrents, coursing down the gutters, were harnessed with dams of mud, making quiet pools in which to wade and sail leaf boats. Carrying cargoes of blossoms, these craft were skippered by a good-natured "Johnny-jump-up." When the roadside river diminished to a trickle, the dam was broken and, in a final flood, "Captain Johnnie" went down the sewer with his ship, a true sailor to the end.

Squash, gourds and pumpkins made sturdy playthings, and I recall a country cousin who played with squash in preference to other toys. Her doll buggy was usually occupied by a warted crook-neck, or a pair of scalloped patty-pan twins, neatly tucked under a blanket. When the garden no longer supplied her with squash babies, she lavished her affections upon a potato, which sprouted a strange assortment of arms and legs before spring.

(Continued on page 442)

Nicotiana

By MAE WINKLER GOODMAN

(Lovely sounding name)
flower of shadow, flower of falling dusk,
you close your petals to the prying sun
and hoard your beauty for a darker lover.
But when the garden swims in amethyst
and phlox and daisies seek the evening's cover,
you spread your waxen petals
one by one,
and hold them open for the twilight's kiss,
while suddenly a scent too sweet to bear
floats out upon a sea of summer air.
Nicotiana, pale crepuscular flower,
the first star takes the sky;
now claim your hour.

Geese on the Wing

Photographic Studies by
Hugo H. Schroder

Above is a skyful of Canada geese that have taken wing from the wild fowl sanctuary of Lockhart Gaddy near Ansonville, North Carolina. (Nature Magazine, November, 1948) Unexpectedly, the Gaddy fish pond became the adopted residence of hundreds, and then thousands, of Canada geese as they came south from their northern breeding grounds. The pond had to be enlarged to take care of the increasing number of visitors, and the problem of feeding them became a serious one. Such a concentration of the birds has attracted large numbers of visitors, and school children in bus loads are admitted free to see the geese. Other visitors pay a small fee that goes for food.

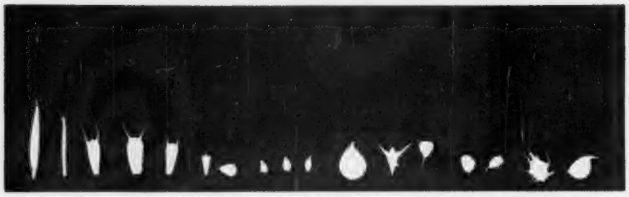
At the left, Canadas in the foreground dabble for food, while, in the rear, others practice nip-ups, heads down for feeding. A few others just swim around, apparently not hungry at the moment.

Canada geese in action as they take off from the Gaddy pond. The two in the lead are so close together that they seem almost one. The two next ones have just completed their run and their wings are going into action, and the last bird is fully awing.

At the left are a number of the birds with their wings set, ready to drop in for a landing on Gaddy's pond.

On the opposite page, at the top, three blue geese, a few of which join the Canadas at the Gaddy refuge, are in full flight, with one Canada winging along below.

Opposite, at the bottom, are several geese taking to the air from the ground. Note the varied positions of the wings of the birds in a sort of composite picture of Canada goose flight.



Actual size of the weed seeds shown on these pages. Scientific names and alternative popular names are given in the captions accompanying the individual pictures. Most popular common names are as follows, reading from left to right; sweetroot; Spanish needles; leafy-bracted beggar-tick; tall beggar-tick; stick-tight; smaller bur-marigold; Virginia stickseed; European stickseed; wild carrot; yellow avens; hounds-tongue; puncture vine; enchanter's nightshade; bracted zornia; Menzies sanicle; sandbur; Canada tick trefoil.

Hitch-Hiking Seeds

Photographs by William D. Barkley

NATURE has provided the seeds of many plants with ingenious ways to travel, so that their kind may be numerous upon the landscape. Some, like the dandelion or milkweed, travel by means of feathery parachutes. Others have air chambers in the seeds, and thus float gaily on brook and river, finally finding a resting place.

As anyone who has deserted city streets for the countryside in the fall well knows, there are many seeds that we know as burs, ticks, needles, or by some unprintable names. Nature has equipped these seeds to be "free travelers." Provided with hooked barbs, spines and hairs, their spread was assured by the ease with which they became attached to the fur or hair of passing animals, and were carried considerable distances before falling off or being rubbed off. Then came man, and these seeds attached themselves as easily to his clothing.

Think how many times one has crossed a weed patch only to discover an assortment of tenacious seeds that have gone along for the walk. And then you stop and pick them off, dropping the seeds to the ground and thus aiding in the accomplishment of Nature's purpose. Most people think of these clinging seeds as a definite nuisance, particularly so when they have to be picked or cut out of the hair of the family dog. However, a close examination of these seeds is a fascinating Nature study. Under the microscope, or under a good hand lens, the clever equipment of each one is revealed to the inquiring mind and eye.

On these pages William D. Barkley, Baltimore photographer, has used the camera lens in place of the microscope, and gives us some clear and informative pictures of a few of these interesting weed seeds. These are, of course, only an introduction, but should serve to make one a bit more conscious of the variety of "free travelers" and the different ways in which they are prepared for their trips.

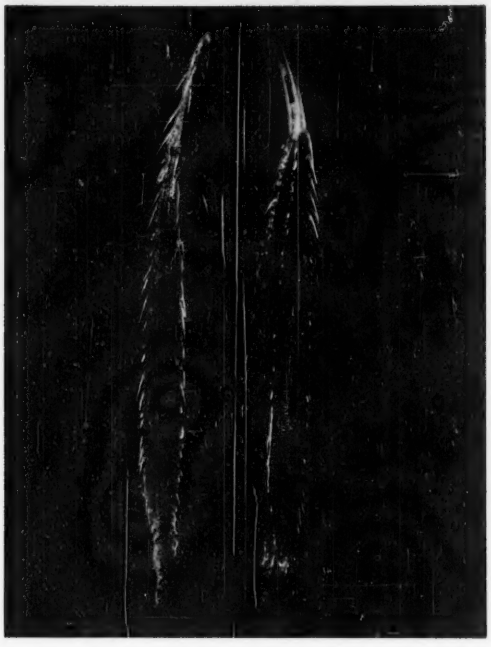
Spanish needles, also known as cuckold, *Bidens bipinnata*, is found in waste places and also in gardens and cultivated fields. It occurs from Massachusetts to Florida and westward to Kansas and Mexico.

Many of these seeds are of great economic importance. They affect the sheep rancher, for they cling to the wool of sheep and often lower its value when they become matted and can only be cut out. Thus the economic botanist studies ways to control the weeds that produce the seeds and to check, so far as possible, their spread in areas where they prove to be costly nuisances.

The seeds, also, can be costly where there are grazing animals. Seeds can become lodged in the mouth or in the alimentary canal of animals, causing sores that may prevent eating and result in death from starvation or infection.

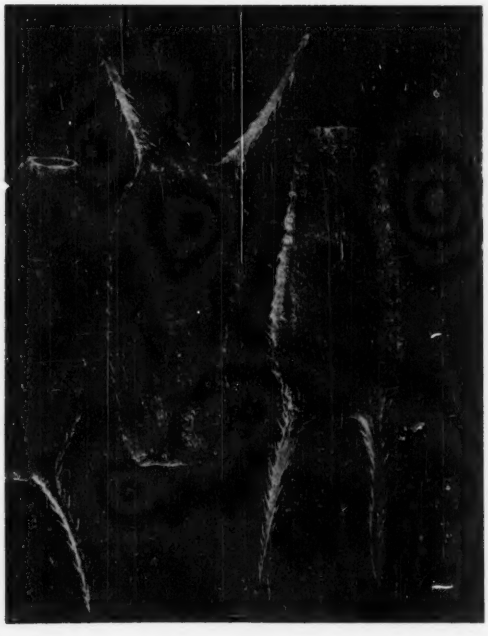
Laws cannot, of course, control the spread of these weed nuisances by bird, mammal, wind, or human skirts or trouser legs, but special effort is made to make effective laws against inclusion of the seeds of noxious weeds among seeds of crop plants, grasses and flowers.

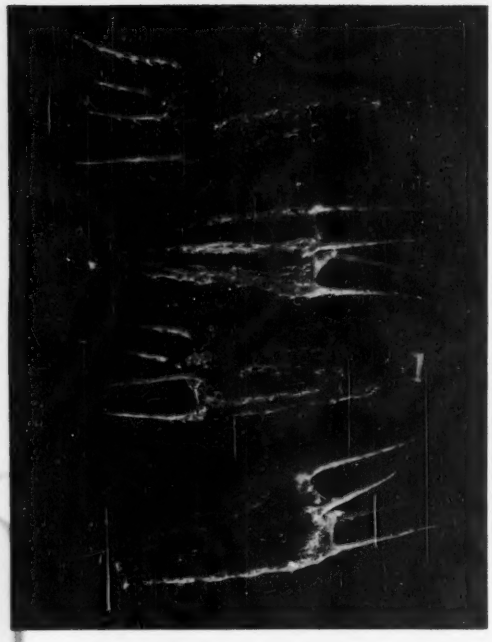
Despite the bothersome habits of these sticky and clinging seeds, however, they merit study. They are outstanding examples of Nature's clever devices. The next time you acquire some of these "free travelers" save a few of each kind and examine them closely. *Weeds*, by W. C. Muenscher, will aid identification.



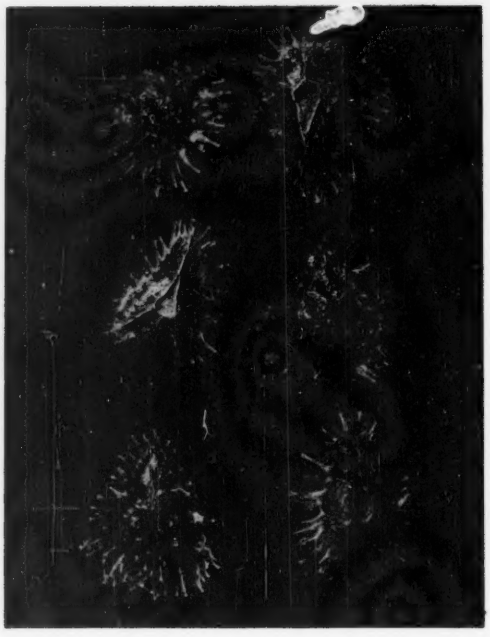
California sweet-cicely, or sweetroot, *Osmorhiza brachypoda*, is found in central and southern California and Arizona. It is a relative of the better known aniseroot. Below is the tall beggar-tick or stickseed, *Bidens vulgata*. It is found widely in the northern United States and southern Canada and is familiar to anyone who has wandered through cultivated fields, in many waste places or along roadsides, or across a neglected farmyard.

The leafy-bracted beggar-tick, *Bidens comosa*, is quite similar to its two close relatives pictured on this page but has an extra barbed spur, or awn, and a narrower body. Below is *Bidens frondosa*, which has several popular names, such as beggar-tick, Devil's bootjack, bur-marigold and pitchfork weed. It is widespread throughout this country, although partial to moist places. The seed is brownish-black and has a slightly tuberous surface.

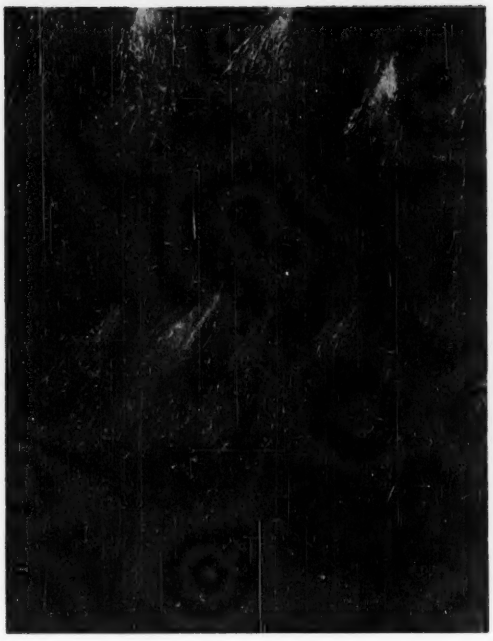




Known as the nodding stick-tight or swamp beggar-tick, *Bidens cernua* is equipped with four barbed awns, which are shorter than the other Bidens shown. Below is the European stickseed, *Lappula enchinata*. Each of the spines on the seed is equipped with a cluster of three to five barbs that look very much like the clutching apparatus on the foot of a fly. This plant is found in the West and there are other westerners in this genus.

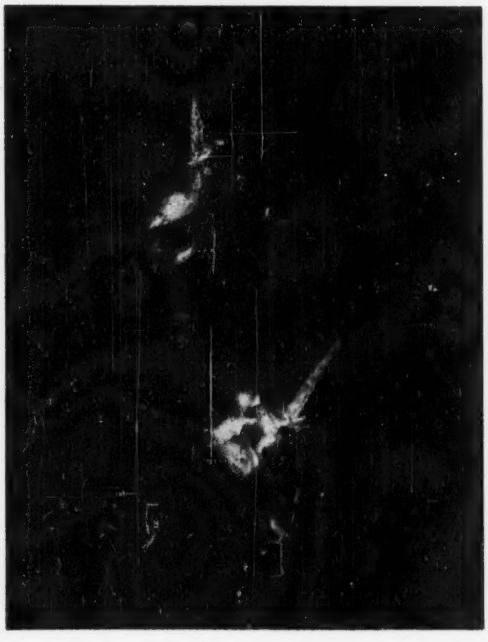


A relative of the stickseed below at the left is the Virginia stickseed, *Lapulla virginiana*, above. The barbs at the tip of each of the spines on the seed form a star-shaped cluster and remind one of the burr on a dentist's drill. Below are the seeds of wild carrot, *Daucus carota*, which is known as Queen Anne's lace or birds-nest. It is an immigrant from Eurasia and now found widely throughout this country. Note its seeds this fall.

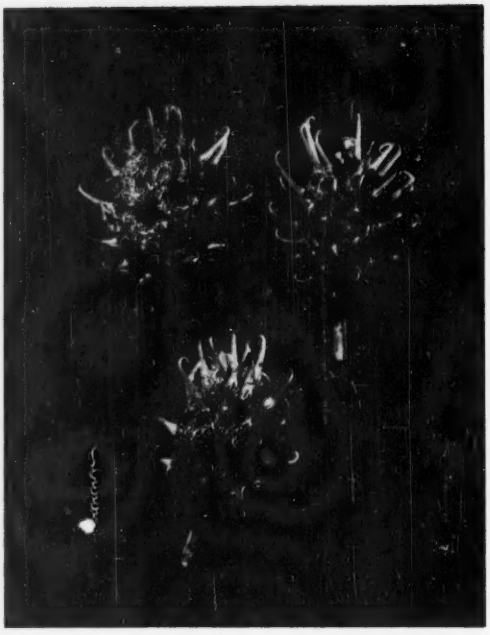


Avens, or yellow avens, *Geum strictum*, has a distinctive and interesting seed. It looks like a mouse with a hooked tail. This plant is a relative of the cultivated Geum and its seeds are similar. Below is puncture vine, caltrop, ground burnut, or tackweed, *Tribulus terrestris*. It is found occasionally in the East and middle West but is more common in the West, from Colorado west and south to California and in warmer situations.

Hound's tongue, dog-bur, sheeplice, or wool-mat, *Cynoglossum officinale*, is an introduction from Europe and is widespread. The seed is covered with stiff prickles that have a single pair of barbs and a hooked tongue on the extremity. Below enchanter's nightshade, *Circaea hertitiana*. The seed is covered with a great number of hooked spines and can only be removed from the coats of animals by cutting, once well embedded.



The bracted zornia, *Zornia bracteata,* is entirely covered with spines bearing minute barbs, but these are so profuse that their removal from fabric or hair is just as difficult as with seeds having hooked spines. Below is *Cenchrus pauciflorus,* known as sandbur, bur-grass, sandbur-grass, bear-grass and hedgehog-grass. Its large, stiff spines can be painful to anyone going barefoot. The plant is found in the East and as far south as Central America.



Sanicula menziesi, or Menzies sanicle, is covered with hooked spines, not quite as abundant but somewhat stiffer than those on the seed of enchanter's nightshade. This seed is a headache to the sheep rancher. Below is the seed of *Desmodium canadense,* tick trefoil, tick clover or sainfoil. The tenacious little seeds are equipped with hooked hairs covering the entire surface and they cling as efficiently as those seeds that have hooked or barbed spines.

Let's Be Fair, Mike

MICHAEL W. Straus is United States Commissioner of Reclamation. As such it is his responsibility to extend the reclamation program of his bureau just as far as appropriations he can obtain from Congress will allow. As a party wheelhorse, it is also Mike's opportunity to keep the political wagon rolling for the benefit of the Truman Administration. He performs the responsibility with a singleness of purpose that is a credit to him in his allegiance to his job, but, we feel, a discredit to him as a servant of *all* of the people. He seizes the opportunity with avidity and ability, and with an eye to where he thinks the most votes will come from.

Mike will not mind our saying that because, in his own words, he is "an old campaigner who has been ground through the mill of experience and whose hide has been toughened and scarred by the barbs of experts." And, being so tough-hided, he will not mind if we say that the evidence shows that he is an enemy of the national parks and the national park ideal; that he would invade any national park or national monument to exploit dam sites within them if he could get away with it.

Right now Mike Straus is much irked because friends of the national parks, individually and collectively, refused to lie down and play dead after his boss, Secretary of the Interior Oscar Chapman, decided in favor of building Echo Park and Split Mountain Dams in Dinosaur National Monument. So irked was the Reclamation Commissioner that he found an opportunity in July, when dedicating the Granby Pumping Plant of the Colorado-Big Thompson Project, to indulge in distortions about this issue, and to attempt some alleged humor.

He called the attention of his audience to "the self-constituted long distance protectors of Dinosaur National Monument, on the Colorado-Utah border." He went on; "From their air-conditioned caves overlooking Central Park in New York, Lincoln Park in Chicago, and Boston Commons in the adopted city of a transplanted western writer who has a tendency to forget his heritage, these self-appointed guardians have taken it upon themselves to safeguard the canyons of Dinosaur National Monument for the handful of brave souls who dare to explore the area by boat. Artificial reservoirs, such as we have before us in Granby, would desecrate the area in addition to making it available to thousands instead of handfuls of people. Therefore these critics contend the development of the Colorado River Basin must make way for the status quo, and that the highest use of your area and resources is a museum and cemetery for Dinosaur bones."

Maybe John Baker's National Audubon Society office in New York, Bill Voigt's Izaak Walton League headquarters in Chicago, and Bernard De Voto's Boston lair are air-conditioned like Mike Straus' Washington office. We can testify that there has been plenty of Nature's heat and humidity in the headquarters of the American Nature Association, the Wilderness Society, the National Wildlife Federation, the National Parks Association, and of others who stand, and have long stood, against precedent-establishing invasions of national parks and monuments for power and irrigation projects. Air-conditioning is not an issue, but truth is.

Let's be fair, Mike. Most of the "self-appointed guardians" have been fighting invasions similar to your Dinosaur project for years. They have been fighting them because they represent a great many of your fellow citizens who feel that we should pass on to coming generations a few examples of what primitive America possessed in unspoiled grandeur, and with them living specimens of the animals, flowers and trees native to them. Perhaps you think this just a lot of waste, Mr. Straus, but there are millions who do not agree with you.

It is, of course, a below-the-belt blow — and you know it, Mike — to declare that those who oppose your plans for Dinosaur want it preserved as "a museum and cemetery for Dinosaur bones." The small area where the prehistoric remains are would not even be touched by the flooding, but the incomparable canyons would. Intimating that those of us who are defending the Monument oppose the Colorado River Basin development is, of course, a deliberate distortion. We have pointed out alternative and less costly sites, the only objection to which has been unproved and dubiously claimed higher evaporation rate.

When it comes right down to cases, Mr. Commissioner, we do not trust you. We know that you want very much to get your toe in as many national park and national monument doors as you can. Doing the job you plan for Dinosaur would be a handy precedent to cite to justify other invasions of park areas for similar purposes. We think it is dangerous.

Your reclamation Bureau, Mr. Commissioner, has made great contributions to our country; performed miracles; can look with pride on much of its record. Tremendous opportunity still lies before it, but it does not, in our opinion, need to exploit any national park or monument in seizing this opportunity.

Perhaps the best answer lies in H.R.5023, recently introduced in Congress by Representative Leroy Johnson of California. It would prohibit the construction or operation of any dam or water-delivery project within or adversely affecting any national park or monument. We are for it, Mr. Straus. Are you?

Has Wildlife Conservation Failed?

By Dr. H. P. K. AGERSBORG

THE term "Conservation," especially as applied to wildlife, has come to have many meanings. Primarily it should mean preservation, and thus should be taken to mean preservation of any resource in its original state, or at least in its current state of well-being. The latter goal is about all we can expect to attain under present circumstances. But some use must be made of what we have left to work with if its preservation is to become the concern of all classes of people who utilize or destroy natural resources. The way in which resources are used must be reasonable, but here has arisen the controversy surrounding the administration of our resources.

The purport of the thesis of this paper is not to advocate the taking away from the people their legitimate rights to fishing and hunting, which they have enjoyed almost unrestrictedly for more than 150 years, but, rather, to safeguard these rights and privileges. It is after many years of serious study and extensive observation all over America that I have come to the conclusions recommended in this discussion.

The discussion here does not in any way advocate taking away legitimate rights to fishing and hunting, enjoyed almost unrestrictedly by Americans for more than 150 years. Rather, it seeks to show the way to safeguard these rights and privileges. Proposals here made come after many years of serious study and extensive observation all over this country —H.P.K.A.

For a long time the protection of our wildlife was considered to be solely a function of the individual States. Belatedly came a realization that there might reasonably be other views, and this finally led to the conclusion that the needs of many species were the concern of the nation. One result of this broader view was the formulation of the Migratory Bird Treaty Act, and regulations under it. These rules, in a measure, took away from the individual States control of the harvesting of game birds that were produced far away, but which, in their periodic movements, were forced to pass successively through various States. The exposure of these transients to persecution by successive attacks had already resulted in the annihilation of one very numerous species, the famous passenger pigeon, and the threatened extermination of several others. Some of these have since met, or seem about to meet, the fate of the beautiful species whose fabulous legions had encouraged the ignorant to believe that their teeming abundance promised perpetual existence in undiminished millions.

Regarding these threatened birds, the growth of protective sentiment among the more intelligent of our people finally resulted in the enactment, and final implementing of this admirable and far-reaching international agreement.

Gradually, as life afforded more leisure, our people learned that many of our wild creatures had qualities that ministered to the mind as well as the body, and, therefore, deserved perpetuation. Fortunately the realization of this point of view, although slow in maturing, seems now to be gaining ground. In this viewpoint, we believe, lies our main hope. The efforts to better themselves when our people began to spread westward followed plans that virtually sought to subdue Nature. Our once great forest was destroyed with axe and fire, our marshes drained, and, in our haste to conquer Nature, every opportunity was seized to accomplish this purpose on a scale as great as our engineering skills would allow.

Our streams have been wantonly polluted. In Idaho, for example, poisonous smoke and polluted water, from smelters in the 69-mile-long Coeur d'Alene valley, have destroyed most plant and animal life from the summit of the mountains to the bottom of the valley; the soil is dead and rapidly eroding away; the streams of the valley also are dead. Neither the States nor the Federal Government are as yet moving adequately to abate such conditions, which are widespread, notably in the oil fields, including highly agriculturalized Illinois.

In our rural areas there should be a balance between plowland and wildlife land that would tend toward a balanced scale in our use of the land. If there were such a balance, wells would have plenty of water all the time, with the water-table high enough to make farming of the uplands profitable, and the farming of bottom lands entirely unnecessary and impractical. However, due to complete disregard of the consequences, lowlands, swamps, and marshes have been drained, rivers have been straightened and channelized, the water-table between the Rocky Mountains and the Appalachian Mountains has been lowered so that most of the bottom lands are farmed, and much of the uplands are too dry for farming. Many of the streams are dry in summer, and many others are little else but open sewers. Not only in our drier sections, with lowered water-tables, may ranchers be obliged to haul water for their cattle many miles during a rainless period, but

also in Illinois and Iowa, during drier periods, the farmer is confronted with the same problem.

An overgrazed forest loses its natural efficiency in controlling seasonal water flowage. Forest-clad hills and mountains let go of the water gradually, thus preventing floods, but when the forest is removed there is no control. The wheat-farmer of eastern Washington will tell you that when the nearby mountains were in possession of a natural ungrazed forest, they were marvelous water reservoirs for the tableland east of Wenatchee. These same mountains, having been shorn of their locks, lost their strength, and the land below them has also lost its productive power from lack of water. Witness also the severe floods in the States of Washington, Oregon and California after much of the Cascades and the Olympics were denuded of their forests. The disastrous mistakes in early land-forest management in the East, excusable in some measure from the pioneers' lack of experience, are being repeated perfectly in the West after a century and a half of experience.

Can a change be made for the better in the conservation of our natural resources?

Can this change be made without an increase in cost to the taxpayer?

Dr. Agersborg says that the answer to both questions is, "Yes!"

When a forest has been cleared of its non-commercial species, and of its down and standing dead timber, when it has been depleted by cutting down everything, and the trash is burned over or killed by smoke, or tramped to death by overgrazing, most wildlife is destroyed also; our children inherit the trash.

In proportion to the money expended on conservation over the past seventy years, the results are shamefully negative. It could have been different if our conservation departments, which are biological departments, had been manned by biologists. For example, in forest situation, forestry and wildlife biology go hand in hand. This is why a forester should be much more than a tree-farmer for the lumber industry, or a lackey to the meat-packers. The forest, with its variety of species other than commercial trees, is of much greater importance in the national economy than has been realized by most schools of forestry. Forest economy is much more than the promotion of growth of trees for the maintenance of the lumber industry. True forest economy involves soil and water economy, wildlife economy, prosperous farming economy, prosperous national economy. The conservation director, to be qualified for his job, should be a bioeconomist of the highest order. No one among educated Americans comes nearer to fit that description than the full-fledged zoologist. Neither a druggist, a chemist, a textile manufacturer, a newspaper man, an insurance agent, a real estate broker, a sportsman, a saloon-keeper, an undertaker, nor some other political pick-up should be placed in charge of any of our basic resources. The job of the director of conservation in any State of this country is that of a well-trained zoologist. All other types are as unqualified for the position as they would be to head a department of zoology in a university. This plain and simple formula will be respected and accepted some day. Why not now?

Mountain slopes, which a few years ago were clad in lustrous green of living soil, are now bare, cold, and dead. It took thousands of years for Nature to bedeck these steep mountains with this green raiment: mosses, grasses, shrubs, trees and their soil. It will take many more years to reclothe them; and even then, they will never be the same, either as to their fauna or flora. Soil once destroyed by deforestation and fire takes hundred of years to be reinoculated with its biota. Since productive soil is never dead, it is important to know the nature of chemicals used in fertilizers or in weed and insect control. The employment of herbicides for supposed encouragment of wildlife is just another way of exploiting Nature.

For the sake of making money, purveyors of chemical compounds encourage the use of destructive poisonous chemicals to kill plants absolutely indispensable for wildlife. Every naturalist knows that wildlife is not aided when its food and habitat are poisoned.

Millions of acres of formerly productive grazing land are barren because the soil is dead. In places where the wild animals were exterminated, and the native flora, with little or no rainfall, was left in complete possession of domesticated animals, the soil was killed. Spots where the natural flora is not entirely extinct, might still be centers from which the desert could derive a new garment. But when they are continually being grazed, the devasted places have little chance to continue as productive greenswards. The land has become devastated because of greed, ignorance, and lack of sensible outlook for the future. Who is to blame for this, the States or the Federal Government? The answer is: Both are to blame. Have the States prevented soil erosion? Have they prevented stream-bank erosion, stream pollution by soil, or domestic and commercial wastes? Has the pollution of rivers and harbors been abated? Is there anywhere in this nation a practical all-over program of action designed to solve these fundamental problems?

It should be evident to anyone seriously interested in the conservation of the wildlife of our country, that the organizations of many of our States, entrusted with the care of our principal natural resources, whether dominated by politicians, uninformed leaders, or selfish or even loyal sportsmen, have not been conserving the resources placed in their charge. Such organizations must have been uppermost in the mind of that noted wildlife cartoonist who, when newly placed in a position to judge methods and results in this field, was forced to conclude that what our officials had been prac-

ticing was *not* conservation, "for in that case we would now have more, instead of less."

That a practical and sensible people should be satisfied with the repetition of errors in wildlife conservation brought on by leaving this important bioeconomic science in charge of people without proper training, outlook, or experience, is very strange. No other scientific field is so stupidly neglected and exploited as the field of biology. Many zoologists are trained every year, and many are retired every year from teaching and research when still at their best, yet, the leadership in biological conservation is placed in the hands of non-biologists. This is surely poor business, and explains why our natural resources are being destroyed. Such impractical Americanism is thoroughly un-American.

However, one should not blame this fiasco in American economy altogether on the appointing officials, because the governors-elect are not better informed in bioeconomics than the average citizen. Moreover, it does not seem that zoologists have ever made any concerted effort to have a zoologist appointed director of conservation in any State of this country, nor to point out to the American people the need for zoologists to direct our conservation efforts.

Is it not strange that in some seventy years of conservation work in America, the appointing official has never even stumbled on a zoologist to appoint him director of wildlife conservation? Seemingly the two do not travel the same lane of life. To be perfectly fair, the zoologist is evidently not doing his duty, either. I believe that he is partly to blame for the fact that he has not been placed in charge of the most important biological work in the State, and Nation.

Can a change be made for the better in the conservation of our natural resources? The answer is, yes. Can this change be made without an increase in cost to the taxpayer? The answer is, yes. However, the public must learn that it is being fooled. The proper type of change will not only save money and resources, but will make much greater profit for less, and for the benefit of everyone.

How is the change to be made, and who is to direct conservation? The answer to this dual question is the key to this paper. A qualified State zoologist, with university trained wildlife protectors having the same status as farm-agents, can perform literally wonders in biological conservation. The leader and his wildlife protectors will work with the farmers and teach them conservation principles much in the same manner as the farm-agent teaches the farmer modern farming. The State zoologist will put to work conservation laws that have proved to be workable. Pollution will be removed from all the natural waters: fresh, brackish, and marine. Poison-mongers will be dealt with.

The national failure in wildlife conservation is due to our lack of understanding of the voice of Nature. If one does not understand the voice, one cannot hear it, and the racketeering poison-monger has a chance to vend his wares, and the profiteering exploiter of soil, forest, water and wildlife can worm his way into the very vitals of the nation.

There is no other answer to the dual question raised above: Put the responsibility of conservation on the shoulders of a qualified State zoologist, and abolish the department of conservation in every State of the Union. Instead of game wardens, the State zoologist should appoint university-trained wildlife protectors who would work with the landowners and farmers to teach them the economy of wildlife conservation.

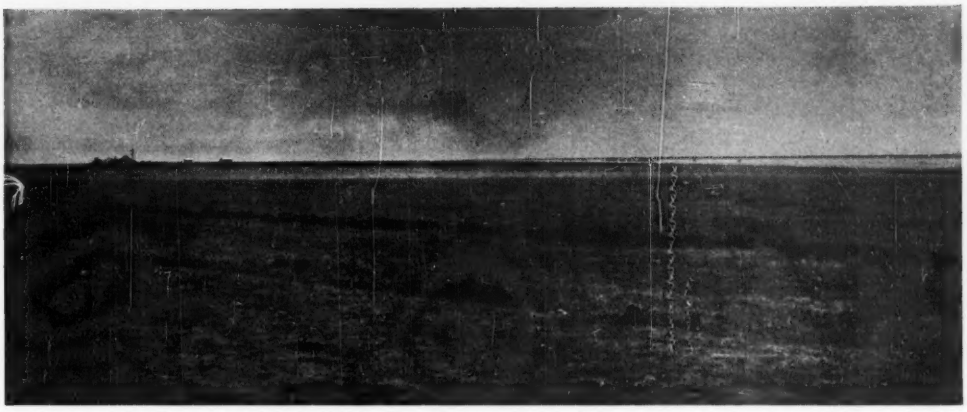
It is said that 90 percent of the wildlife in the United States is produced on private land. This being so, why have the conservation departments? Wildlife is a crop and surely belongs to the owner on whose land it is produced, inconsistent notions to the contrary notwithstanding.

In a proper land economy, all streams are freed to a minimum from soil-wastes, and domestic and commercial pollution; the plowland is considerably removed from the stream-banks, and the watershed is not devoted to crop-raising and grazing alone. In such an economy there is considerable natural wildlife land, which, of course, is not farmed or grazed. Since the farmer pays taxes on all his land, he needs all the crops raised on his land; that is, both the domesticated plants and animals, and the wildlife, fish, game and fur bearers. It seems rational that no one should have the right to take any of his crops without paying him.

Since the State conservation departments claim the right to the farmers' wildlife crops, although they have done nothing toward a proper land economy in their seventy-year history, it is no wonder that the farmers do not become more vitally interested in wildlife conservation. The conservation departments take charge of the wildlife crops without offering any compensation to the man who raised them. Another State department burns over millions of acres of public land along the highways, and the railroad right-of-ways are burned over every year. Nesting sites for millions of ground-nesting birds are thus destroyed right under the eyes of the conservation department's personnel. Surely, no other American business enterprise is operated in such an abortive manner.

Good wildlife land is land in reserve. It always makes better adjacent farmland. In proper land management, the landowner receives many unearned increments. The importance of this fact should be cultivated. Its application cultivates the finest type of citizens, and is the most fundamental principle in stable-minded citizenship.

The Federal Government, through a carefully selected three-man committee — a botanist, a geologist, and a zoologist — with scientifically trained secretaries, should supervise the Federal Government's activities in conservation of renewable resources on government lands This committee should stop all destructive interests in their exploitations of natural recources, and see to it that the Federal agencies entrusted with conservation work are doing the work as it should be done.



A "blue norther" moves in over Texas, changing springtime into something quite different. It has its origin in Canada and an air mass from that region.

Seven Seas of the Air

By BOB CORRIGAN

THE WIND has a sharp edge today, and there must have been big doings over Medicine Hat.

That is where the weather used to come from, in loops and swirls over the continental map, before anybody bothered to identify the Polar Canadian air mass. When we got weather that failed to fit the forecast, we could not complain; who could expect the wind to read the map?

Then came the war-before-last, and we learned that Hitler was rolling across the horizon with the aid of the new "meteorology" invented by a Norwegian physicist named Vilhelm Bjerknes. It was a system of air masses — a theory so simple and complete that it cut through and rationalized the whole previous ponderous jumble on the subject.

Polar Atlantic air mass number two came fully into our consciousness on October 11, 1941, when the Coast Guard announced seizure of the cutter *Busko* with scientific equipment and a crew of Nazi observers. The capture was on the fringes of Greenland, where the meteorologists were to have observed the weighty stirrings of this air mass. Weather had become a basic weapon, and the checking of this polar mass a major means to use it.

A couple of months later we found ourselves fully engaged in the war, and there were no more weather reports for a long time. They were a military secret, as important for us to use as for us to keep from the enemy. Meanwhile, we were generally getting the idea that the interaction of seven separate seas of the air with individual characteristics was the governing factor in all our weather. When we began to get the reports again, in the short and strenuous interlude that we thought, for a while, was peace, it was noticeable how much more accurate they were than they had ever been before.

Mention of two of these air masses has been made without indicating their basic characters: Polar Canadian and Polar Atlantic. The first resides in Canada and is generally cold, dry and hard. The second works out from the general area in which Hitler's perhaps unwilling stooges were to have observed it, the North Atlantic region. It, too, is cold and hard, but wetter.

Next there is Tropical Gulf, and it is warm and moist, much like the Gulf Stream, which arises in the same locality and has so much to do with the climate of Europe. This mass is roughly matched by Tropical Pacific, the air of the South Sea Islands, which sometimes comes to visit southern California.

There is also Polar Pacific, with odd traits somehow picked up over the peculiar Soviet region of Siberia. These are modified by its travel across the Pacific on its way to visit us here.

The sixth is a high, hot air mass drifting in from above the Galapagos Islands, seldom reaching the ground, but capable of searing the surface if conditions ever let it touch. It has been given the fancy name of Sec Superieur ("The Higher Dry"), and it does a fancy job in combination with Tropical Pacific and the home product, our last in the catalog.

This is the Tropical Continental mass, forming over the deserts of Mexico, Arizona and perhaps New Mexico, and seldom leaving them. In combination with the two last mentioned it can produce the cloudbursts and flash floods that are notable events in the region where water is scarce or much too plentiful.

Among these seven seas of air are practically all the ingredients of the weather in the United States. Acted upon by the rotation of the earth, by the seasonal tilting of the earth's axis, and by the slightly varying volume of energy received continuously from the sun, they react variously upon each other and consistently upon the land and water at their bases.

When the great polar masses, for instance, get heavy enough to start rolling down under the continental air, they set up a "front," which throws storm and stress along and before its length as the blade of a bulldozer will heave snow and rocks and branches from a roadway. That, of course, comes only along the front: back in the cab, at Medicine Hat, all is serene and lovely.

Out in Chicago I once met a doctor from Alberta, and hurt his feelings badly by mentioning that we got our storms from Medicine Hat.

"Why, we have a wonderful climate!" he protested. "It just happens that we had one of the first meteorological stations on the continent, so because we gave you reports on weather conditions, you want to blame us for your storms down here!"

Anyway, when the flare and fury from such a Polar Canadian push gets to Texas it is called a "blue norther;" and all the horizon-wide color blanket of the spring bluebonnets has less effect.

As for the Polar Pacific, when that gets dense enough to move out on us, it arrives over the Washington coast line full of moisture from the Pacific. Pushing against the Cascade Range, it rises, condenses its moisture, and drops a generous flow of rain to keep that coastal region always lush and green. Then, rolling down the eastern slopes, it dries out, warms up, and takes on some of the characteristics of Tropical Continental. In this phase it sucks up moisture out of the desert-like areas in its path. Then, boosting itself over the Rockies, it once more distributes its wetness over regions like the Coeur d'Alene of Idaho and Montana, goes over the top, dry and searing, and descends the slopes to the east as the harsh, burning chinook wind.

By this time Polar Pacific has picked up a net increase of about twenty degrees in temperature; and it arrives over South Dakota in condition to do practically nobody any good. Now it really resembles the typical Russian export of the last thirty years — an ill wind of disruption.

For the air masses over the tropics, these get the urge to roam when the pull of the heat fills them up to great altitude with water vapor, and they begin to drift toward the poles. Their overriding of cooler air masses beneath is the cause of a line of stress that is again a "front" marked by torrents, hurricanes and general roughness. A movement out and up in the direction of the North Pole brings all the strains and stress of storm to us as the shoving edge of the mass produces conflict with the sea of air normally present over this continent.

Symptoms of these air migrations are still the barometric pressures, wind direction and velocities, humidity percentages and air temperatures, which used to be considered the causes. They are no longer looked on as causes, but more properly as effects. The causes stem from the ponderous progressions of the seas of air themselves; and you can readily see how hurricanes or blizzards will occur along a front, when the basic factor is the glacier-like movement of an immeasurable mass of air, by considering the action of a tornado.

That can whip up such speed and pressure as to move whole houses into the next county, or to drive wax candles through oak planks; but the whole disturbance moves over the ground at only about thirty miles an hour. You can readily run away from the funnel in any old jalopy.

So there is a new day in weather forecasting, to the great advantage of fliers and fishermen. And what is the prospect for tomorrow?

Fair and warmer — unless it snows.

Thoughts from the Backwoods

By OSCAR OSTLUND

Can there be among the million, million stars a greater wonder than your own free will and thought? The free individual, aware of this wonder, is armored with conviction that makes him unconquerable.

* * *

The starlight sparkles through the deep, abysmal night. The copious beams from the galaxy in the remoteness of Andromeda will not be turned back by the aweful opposition of the astronomic darkness. Neither can the light of free thought be suppressed by the Kremlin's desperate, enslaving power.

* * *

The creative surge of ideas is as inborn in the nature of man as the energy of lava boiling in the earth's interior, pushing for an outlet.

* * *

Nature, considered in the wholeness of its substance, motion; tone and luster (its intangibles) is the original rootstalk, the living sub-structure of human ethic, poetry, religion and morale.

* * *

Nature is the mirror through which you may see some concrete glimpses of the ineffable Being that men call God.

"Doodles" pushes away from his baby grand after having rendered a resounding concerto, and is bowing deeply in response to the plaudits of the audience — or so it seems.

"Doodles" Was A Loris

By MAUDE E. SKAU

WHEN Dutch colonists came to the East Indies they saw a curious little animal, one of the lemurs, and they called it *loeris*, which means clown. This descriptive word became the generic name for the slender loris, *Loris gracilis*, common to the forests of southern India and Ceylon.

More widely distributed through India, Indo-China, the East Indies, Borneo, the Malay Peninsula and the Philippines is its relative, the slow loris. This loris has been given a different generic name, *Nycticebus*, and there are a dozen species. The generic name means "night ape," for these animals are tree dwellers and nocturnal, and one of the species is *tardigradus*, which means "slow step." The slow loris is indeed slothlike in its movements.

The slender loris cousin to the south is called *Thevangoo* in the Tamil tongue. This means a skinny or thin person, and is applied also to a thin and sick human, as well. Writing of this loris, S. V. O. Somanader, Ceylonese naturalist, says: "From dawn to sunset, the loris rests in the hollow of a tree, or in the forks of branches, curving its body, or rolling itself, somewhat hedgehog-fashion, into the semblance of a ball. Russet-coated in color, with a woolly fur, the loris is not only slender-limbed but tailless. It has large, circular eyes directed forward and separated merely by a narrow space and a protruding nose just below and in between.

"The loris hunts birds, insects, frogs, lizards and other small vertebrates, and varies its diet with leaves, young shoots and wild fruits. In captivity it feeds on rice, milk, fruits like plantains and papaws, and vegetables. Few people, however, rear the loris as a pet, and fewer still, because of its nocturnal habit, its shy and retiring nature and its general weird appearance, regard it as a lovable and lively pet.

"Although the loris in the wild descends to the ground occasionally, its choice is the trees. The animals are usually solitary or found in pairs. The loris brings forth only one baby at a birth, the young clinging to the ventral side of the mother's fur and being carried about in that position wherever she goes."

Mr. Somanader feels that the slender loris is an undesirable pet, but after long years with "Doodles" we must differ with him. Our little loris came to us when about three months old. First we fed him with a medicine dropper, since he weighed little more than the half-ounce at which he tipped the scales at birth. He graduated to milk placed in a flat saucer on the floor. He would run through this, full tilt, then lick his hands and feet clean. There would be a good deal of milk on the floor, to be sure, but also enough in his stomach so that he was not hungry. Soon, however, "Doodles" learned to drink properly from the saucer and and was very neat, never spilling a drop.

When the sun set our pet would become active, using the

The loris weighs in at an even pound but is so fascinated by the pointer that records the weight that he refuses to look at the camera. Below, three loris show an excellent taste in reading matter.

curtains for his trapeze, hanging head down, or "skinning the cat" by threading his head and shoulders through his legs and resting his elbows on his little behind.

"Doodles" would come to anyone who held out a hand, particularly if the welcoming arm made a bridge over which he could get to me. He seemed to accept me as his mother, coming to me as soon as he awakened from his daytime slumbers, seeking me out wherever I might be in the house. He slept in the armhole of a dress, or sweater, hung behind the door in the bathroom.

Our loris wore a coat of thick and silky gray fur, with

The carrying basket in which "Doodles" made his travels in safety and in relative comfort.

a dark stripe up the center of his back. His fur under his chin was a rich canary-yellow. His eyes were a soft brown, with long eyelashes, while the "whites" of his eyes were a light blue.

During the evening, when he wanted to be petted, "Doodles" would come and lie on my shoulder and lick my ears and neck. This was a signal that he wanted the affection returned, and he would hold up an arm so that I could scratch or stroke his side. Enjoying this, he would puff out his tummy on one side and then the other, making the skin tight, the better to enjoy the scratching. When the loris held up an arm to be scratched my husband would say, "Heil Hitler." Then the other arm would go up in a salute. This impressed friends, but really "Doodles" wanted to be scratched on the other side and held up the other arm for that reason and not because of any Fascist predilections.

Our pet was equipped with a good set of teeth, which he used freely in playing. They were his only means of defense, except for bluff. He was good at that and would jump menacingly toward a strange cat or dog, regardless of size. I have seen dogs that would kill a rat with one bite back off and lie down as though to say, "I'd better leave this fellow alone."

In India, when the evening lights are turned on, many insects fly in at every opportunity. Then "Doodles" served as an insect exterminator, for he relished any and all creeping things and was an excellent hunter. If there was a moth high on the wall the loris would climb to the tip of a cane pointed at the insect, hold on to the cane with his feet and grab the moth with one swift sweep. He could reach thirteen inches in any direction. Fully grown, "Doodles" tipped the scales at one pound, but he was quite fat for a slender loris, although he was not a heavy eater. Many kinds of fruit were favored, and two tablespoons of slightly warmed milk satisfied him.

"Doodles" was called many things by the press, among them "The Thing." He was also described as the navigator of a flying saucer. To us he was just a lovable and distinctive pet for a good many years.

★

Gray Day

By GILEAN DOUGLAS

Dove flight of ripples burnishes the sea
As mice of rain scamper the granite shore;
Immobile on dun rocks two herons pour
Their patience into profit; somberly
The clouds spill twilight ashes and once more
The mole of darkness struggles to be free.

The Eloise Butler Garden

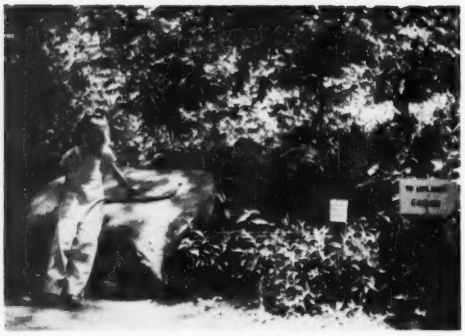
By DOROTHY WALTON BINDER

A TEN-minute drive from the heart of metropolitan Minneapolis takes one to the Eloise Butler Wild Flower Garden, an outdoor museum containing every wild flower indigenous to Minnesota, and many from other parts of the United States. Nearly 50,000 visitors enjoyed it last year.

It was not always so. For many years the garden's existence was known to only a handful of Minneapolitans, who were entreated to keep secret the whereabouts of certain rare plants that might be destroyed by careless picnickers or vandals. The garden survived cyclones, forest fire, drought and financial depressions as a sort of neglected step-child of the Minneapolis Park Board.

At the beginning of the century Eloise Butler, a tiny high school botany teacher with a strong Maine accent, was finding it increasingly difficult to take her students on field trips. Minneapolis was expanding so rapidly that the haunts of many species of native wild flowers were being wiped out by the building boom. Miss Butler conceived the idea of finding a plot of ground within easy access by city transportation, upon which typical Minnesota wild plants could be grown.

She found the ideal spot in what was then called Glenwood Park, more recently rechristened Theodore Wirth Park, in honor of a brilliant and public-spirited park superintendent. This is a large tract of both rolling prairie and heavily wooded land, with several small ponds. It has been kept largely in its native state. Miss Butler chose a secluded wooded area of three acres near a marsh and infested with mosquitoes. The mosquitoes acted as a deterrent to visitors, and Miss Butler could not only transplant with a feeling of security, but could practice experiments on mosquitoes as well! In 1907 the Wild Flower Garden was informally opened with a census-taking of all its indigenous plants. Miss Butler immediately began introducing other plants not already there.



A young visitor rests by the plaque in memory of Eloise Butler at the entrance to the wild flower sanctuary that bears her name.

When she retired from active teaching a few years later the little botanist became full-time curator of the garden. Guarding her botanical secrets from all but a chosen few, she worked from early spring until frost, bringing in from all parts of the State flowers that were fast becoming rare.

From the first Miss Butler thought of this garden as a "sanctuary," and such it was. She believed that Nature should be allowed to have her way, and that typical weeds should have their place along with wild flowers. Her theory all but ruined her long years of devoted labor, for the weeds soon began to take over. The jewel weed, which grows shoulder-high and spreads like wildfire, ragweed, poison ivy and numerous thick grasses choked out the rare and less hardy wild flowers. Upon Miss Butler's death, in 1933, it was necessary to wage a relentless war on weeds to save her precious plantings. That war is no longer a hot one, but the curator and the Park Board employes are continually on the alert against further harmful invasions.

Curator of the Eloise Butler Wild Flower Garden is Mrs. Martha Crone. She stands in a path in the upper garden.

Several years before her death, the garden had been named in honor of Miss Butler. When she died an oak was planted near the entrance and her ashes were scattered nearby. A bronze plaque, attached to a huge boulder at the point where the visitor normally com-

mences a walk through the garden, commemorates the little botany teacher from Maine, and her unique gift to her community. Mrs. Martha Crone, who had worked many years with Miss Butler, succeeded her as curator.

Much has been learned since Miss Butler's day about the scientific "care and feeding" of wild flowers. Many woodland flowers need an open woodland and refuse to grow in a thicket. Lady-slippers like acid soil; fringed gentians prefer alkaline soil. So much of the labor of reestablishing the garden after the battle of the weeds was scientifically to provide the proper soil and environment for each plant.

Although the wild flower garden is a part of the city park system it has never received much of the budget. The Park Board has never felt it could afford to do much more than keep the status quo. Fortunately an "angel" appeared in the form of Mr. Clinton Odell, a leading businessman who had once been a student of Miss Butler's. Finding it more fun to battle with weeds and to help Mrs. Crone introduce new plants than to play golf, Mr. Odell has given up his weekends to manual labor. He also has been responsible for fences to keep out vandals, a watering system for hot, dry summers, spraying to eradicate mosquitoes, and extra labor to supplement that of the Park Board. He is currently engaged in trying to establish a fund to guarantee perpetuity to the garden.

Originally the garden was to have harbored only plants indigenous to Minnesota. But in recent years Mrs. Crone has been experimenting with establishing plants from other regions. So far azalea, rhododendron, mountain laurel, and various trilliums not native to Minnesota are growing successfully. Seeds are being exchanged with other parts of the United States and attempts made to introduce wild flowers not native to Minnesota. Mrs. Crone has set out more than 40,000 plants. This spring a lotus bed was started.

Now that there are fences, paths and someone constantly on duty in the garden, the whereabouts of rare plants are no longer kept a secret from the Minneapolis public. The three acres have expanded to thirteen, which includes a relatively new upland garden with hundreds of plants accustomed to open prairie terrain. Attractive signs in the park guide the visitor to the garden, and publicity encourages Minneapolitans to visit their wild flower garden. Plants are clearly labelled so that they will become familiar friends. New gravel paths wind picturesquely through the woods and up the hill to the open highlands. Benches lure the footsore to linger and enjoy the superb skyline view.

May is probably the favorite month in the garden. Minnesota traditionally throws off winter like a quick-change artist. One week there is still ice in the lakes, snow on the ground and people are wearing winter coats. The next week the sun is as hot as summer, and the snow trilliums have magically appeared over night. From then on the garden is a succession of bloom. Hepatica, bloodroot and trailing arbutus follow the snow trillium. Marsh marigolds gleam in clumps in the sunny swamp. Red, white and yellow trilliums are in profusion. The lacy-white foam flower looks like snow on the hillside. Some twenty varieties of violets — white, purple and yellow — bloom along the "violet path." Five varieties of wild orchids lift up their delicate pink, white and lavender "slippers." The showy lady-slipper, Minnesota's State Flower, can no longer be found wild near the Twin Cities, but here it has found a haven. The Minnesota trout lily, which has become virtually extinct, is growing happily in the garden.

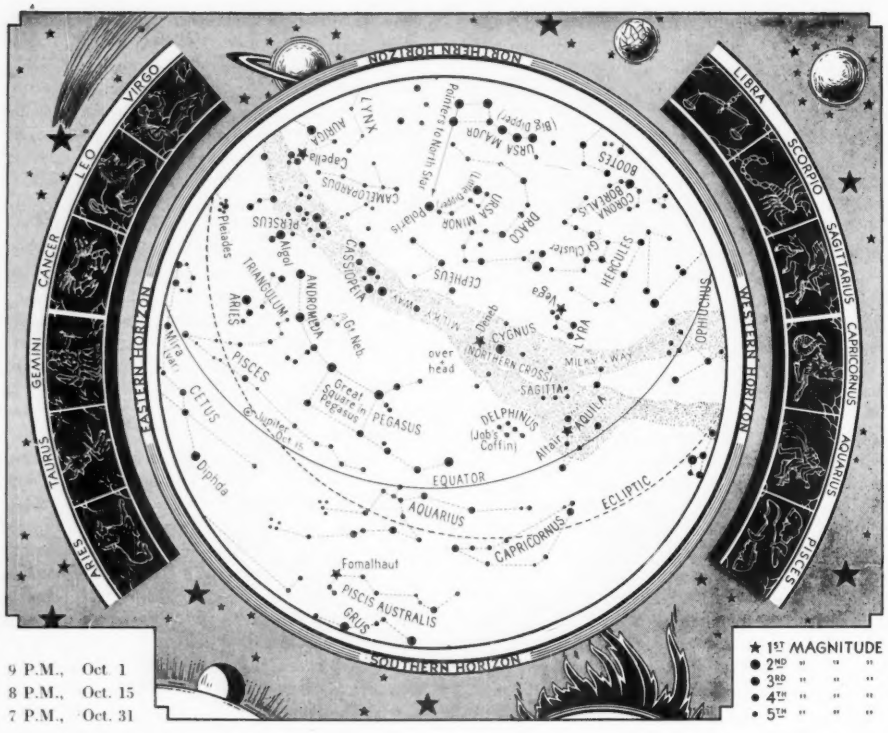
In the upland garden pasque flowers come first, followed by birdsfoot and sand violets. Trees and bushes are budding and are alive with birds. Although no longer precisely a wild flower "sanctuary" the garden *is* a bird sanctuary and much frequented by the local Audubon club. From early April until the goldenrod and wild aster bow out before Jack Frost, science and Nature join hands to give the people of Minneapolis a constantly changing outdoor museum. Eloise Butler's legacy is growing and giving pleasure with the years.

★

Fields Newly Planted

By GRACE STILLMAN MINCK

The fields are empty lengths, each spiraled gray
In patterned, dust-spun earth; they watch and wait
For the fulfillment of old vows that say,
"Again, you will hold wealth in young, green freight
Of succulence for man and beast." Winds swirl
Above their solitude; rains kiss them well;
The cycling seasons whisper "Patience" — Then,
One night, the infant stalks reach up and hurl
Gray, dusty coverings aside, to tell
A waiting world of miracles again.



To use this map hold it before you in a vertical position and turn it until the direction of the compass that you wish to face is at the bottom. Then, below the center of the map, which is the point overhead, will be seen the constellations visible in that part of the heavens. It will not be necessary to turn the map if the direction faced is south.

How Stars Differ One from Another

By ISABEL M. LEWIS

No one would suspect, from a casual glance at the heavens on a clear dark night, how infinitesimally few of the billions upon billions of stars that exist in space are visible without the aid of telescopes. Indeed, one would not realize how great is the number of stars that lie even beyond the reach of the greatest of all telescopes, that on Palomar Mountain.

One thing about the stars that even the casual observer will notice is that there is a considerable difference in the brightness of the different stars in his night sky. This difference in the apparent brightness of the stars carried to the faintest of the telescope stars is far greater than the observer dreams. The difference between the brightness of stars is expressed on a magnitude scale in which one magnitude difference corresponds to a difference of about 2½ times in brightness. A difference of 5 magnitudes corresponds to 100 times in brightness, 10 magnitudes to 10,000 times in brightness, and minus magnitudes have been devised on the same scale to take care of the exceptionally brilliant objects. On this scale the sun is of the −26.8 magnitude, and Venus, when brightest, of the −4.4 magnitude. Sirius is the brightest of all the stars in apparent magnitude, and is, on this scale, of −1.6 magnitude. There is a zero magnitude for stars brighter than standard first magnitude stars by one magnitude. The faintest star visible without the aid of a telescope in our night sky is of the 6th magnitude. With the most powerful telescopes images of stars of the 21st magnitude can be seen on photographic plates. On this scale, in which every five magnitudes makes a difference of 100 times in brightness in geometrical ratio, the difference of 22.6 magnitudes between Sirius and

the star of 21st magnitude means that Sirius has an apparent brightness about 4 billion times that of the faintest star that is now observable.

Apparent magnitudes tell us nothing of the true brightness of the stars, and to compare stars as to their light-giving power, or real luminosity, a standard distance of approximately 33 light years (ten parsecs) has been adopted. The apparent magnitude that a star would have at this distance is called its absolute magnitude. If this can be found, as it has been in many instances, the star can be compared with others whose absolute magnitudes are also known, as regards their *real* brightness, with the brightness of our own sun as a unit of comparison. At this standard distance the sun would be slightly brighter than a star of the fifth magnitude. Sirius, the brightest of all stars, at a distance of 8 light years would be only a star of first magnitude at standard distance of 33 light years.

Brightest of all the stars in absolute magnitude are the abnormally bright supernovae, which flare up so briefly in great galactic systems, including our own. These supernovae have absolute magnitudes around −14. That is, at a distance of 33 light years a supernova would shine with a brilliancy equal to the combined light of ten thousand bodies as brilliant as Venus at her brightest. The star S Doradus, in the Greater Magellanic Cloud, is intrinsically the most brilliant of all the stable stars, although apparently a faint telescopic star. The absolute magnitude of this star is −9, or about 100 times brighter than Venus when near her greatest brilliancy. A certain O-type star, the hottest of all types of stars, which is also in the Greater Magellanic Cloud, is of −8 absolute magnitude. At the other extreme of the absolute magnitude scale we find that the faintest of all stars is one discovered a few years ago by Van Biesbroeck of Yerkes Observatory. The absolute magnitude of this star is 20. There is a range of 29 magnitudes between this star and S Doradus. This corresponds to a difference in real or intrinsic brightness of approximately 400 billion times!

Stars differ tremendously not only in true and apparent brightness but in many other important respects, such as temperature, color, size, mass, density, and variability of light, which arises from internal changes or instability, or from temporary eclipse by a companion body passing between us and the star.

Colors and temperatures of stars are closely associated. Excessively hot are the central stars in the gaseous planetary nebulae, the blue-white Orion stars, and the O-type stars, which are among the hottest of all. Surface temperatures of these stars are variously estimated from 80,000 to 35,000 degrees Centigrade. The lowest known temperature of any star — 1600 degrees Centigrade — is that of Chi Cygni, at its minimum brightness. This is a long-period, variable star of the same type as the well-known Mira, or Omicron Ceti. It has a range of ten magnitudes, or 10,000 times in brightness between maximum and minimum radiation. From blue-white through white, yellowish-white, yellow, orange, to red, the various types of stars run progressively with decreasing temperatures. There are red giant, red dwarf stars, and red carbon stars, the latter in considerable numbers. There are very few deeply red stars that are visible to unaided vision. Antares is definitely red. Arcturus and Aldebaran have an orange tinge, and Betelgeuse is more orange-colored than red. Sir William Herschel's "Garnet" Star is visible to the naked eye, and is one of the reddest of stars. There is also a reddening of the light of stars that comes great distances through interstellar space.

The diameters of the stars differ greatly. That of the sun is 864,000 miles, 109 times the diameter of the earth. The diameter of Betelgeuse is about 300 times that of the sun, that of Antares is about 400,000,000 miles. Alpha Herculis is another red giant star of great diameter, possibly greater even that that of Antares. The smallest of all white-dwarf stars, known only by its catalog number, has an estimated diameter of only 1/200 that of the sun, that is a little more than half the diameter of the earth, and some dwarf stars have diameters comparable to that of the major planets.

Stars appear to differ less in mass or quantity of matter they possess than in other respects. The most massive stars are the O-type stars, also among the hottest. Yet these stars do not have masses much more than 100 times that of the sun. Near the other extreme are stars with masses only a small fraction that of the sun; but a lower limit of 1/20 that of the solar mass has been assumed as that below which a star would assume planetary rather than stellar characteristics.

The densities of the stars vary tremendously because of the enormous differences in diameters and volumes. The density is the amount of matter per unit of volume. When the mass and volume of the star is known its density is easily found. At one extreme are the excessively rarified red giants, such as Betelgeuse, which has only 1/2000 of the density of air at sea-level, and at the other extreme are the white-dwarf stars, such as the companion of Sirius. The smallest white-dwarf, mentioned above, has a density that has been estimated to be as high as 620 tons per cubic inch. That of the companion of Sirius is about 15 tons per cubic inch.

(Continued on page 443)

Star of Autumn

By RAY ROMINE

The bright elusive Fomalhaut,
Her colors flaming high,
Austerely crosses, on tiptoe,
Her empty stretch of sky.

Her regal bearing shows disdain
For small stars which in awe
Behold her go far south to reign
When summer days withdraw.

The princess struts; we pay the cost:
Her cold aloofness leaves us frost.

The School Page

By E. LAURENCE PALMER

Professor of Nature and Science Education, Cornell University, and Director of Nature Education, The American Nature Association.

WEST COAST NATURE NOTES

THE LATEST reports of the Iowa Academy of Science has just come in the mails. In it is an article on the "Professional Status of the Biologist." In its introductory statement, we read: "The term 'biologist' may suggest a person who didn't quite succeed as a specialist." The article continues in an apologetic mood, explaining, defending and excusing the use of the term biology and biologist as representing respectable aspects of science. To me it is absurd. Is it not conceivable that able, respectable persons might sometimes consider that the greatest opportunities for a full, useful and happy life may not rest in the field of specialization? Synthesis may be as important as analysis. The terms "biology" and "biologist" need neither defense nor apology when one honestly recognizes that they call for greater understanding and better mastery of wider fields than may be required of the specialist. Besides, honest investigation, service, or accomplishment, in any field by able persons, need no apology.

One might assume from the article quoted that one can claim to be a "scientist" without blushing, but must merely whisper that he is a "biologist," and probably should not even dare think that he is a "naturalist," or would like to be one. How absurd this all is! How more challenging it is to be a coleopterist than a specialist in the Elateridae; an entomologist than a coleopterist; a zoologist than an entomologist; a biologist than a zoologist; a naturalist than a biologist, and a nature educator than a naturalist! Is it not possible that some of our biologists have been recruited from those who have succeeded as specialists, and who have recognized wider and more fruitful fields of investigation and service? Does specialization offer the only challenge, the only dignity? Must we assume that one interested in broad fields has no mastery in any special field? It is not what one claims to be that counts. It is what one is, and it is entirely immaterial how wide or how narrow that field may be so long as it represents integrity, ability and accomplishment.

I have just flown back from the west coast, where I attended meetings of the American Association for the Advancement of Science, The National Education Association and the West Coast Nature School, and where I saw other groups in action. One group that blatantly claimed they were scientists interested in teaching explained how they had encouraged children to make collections of birds' eggs, on the assumption that it is better to make one's own collection than to use the work of others. There was little objection from the assembled authorities, in spite of the fact that the making of such collections without Federal permits is illegal. When this was called to their attention, it was passed off as being inconsequential. I sat in one discussion group that was weighing the merits of the orthodox as against the modern organization of biology, without these terms being defined. While I sat there, a spotted towhee came almost to my hand, a California quail gave its call, which sound most unquail-like to an Easterner, and a mockingbird did its best to outshout the assembled educators. I doubt if 10 percent of the "scientists" exposed to this experience had much more ability to avail themselves of the ornithological opportunities presented than to be able to spell properly the common names of the birds. Certainly, they registered no interest in these birds. Not far from my chair as I sat there was a gigantic *Monstera*, weazened representatives of which you can see in almost any hotel lobby, but it meant nothing to these "scientists," and I was able to find but one who could name it for me when I casually asked them about it afterwards. I rather think that we can go "haywire" in any direction if we wish. We can become an absurd specialist, or an equally inane generalist, and if the title of biologist lacks professional status, then it is the fault of inadequate individuals who use it, not an indictment of able persons who are proud of it. It does not mean that all biologists lack stature or opportunity.

I liked tremendously most of what I saw in the West on this trip. I liked the frankness with which the West Coast Nature School, now in its third decade, just honestly says it is teaching Nature Study, yet it is staffed by a college president, a dean, a department head and similar individuals, most of whom have Ph.D.s in science and most of whom are members of Sigma Xi, although I did not see a single key on the lot. I doubt if one of them assumed leadership in these broader fields because he "did not quite succeed as a specialist." If they did, I heard no expression of regret on their part, although I had ample time to get acquainted with their basic philosophy.

Incidentally, I cannot leave consideration of this west coast school without commenting on the pleasure I got from my stay in Sequoia National Park and King's Canyon National Park, they and Mammoth Cave being the only national parks outside Alaska that I had not visited. They provided a fitting climax to a long series of happy experiences. It was fun to go to bed early in the evening in the heart of things without having to listen to a dance orchestra or a blatant radio turned on to the full.

I cannot here review all of the thrills of those park days, but I must mention a half-day spent alone in the blazing sun on Beetle Rock, of a half-hour hike alone towards midnight in faint moonlight through the enormous Sequoias, a few minutes with a doe and her newborn fawn, other minutes with a white-headed woodpecker, and still others with a western tanager. But there I go. I must stick to my subject, even though I should like to tell you the excitement of catching my first grunion in my naked hands at 2:00 in the morning, and of seeing grunion eggs hatch in just 90 seconds after I poured sea water on them. Had I stuck to my field of specialization, in which I believe I once attained some slight stature and know I would have attained more, most of these satisfactions would have been denied me. And were I a textbook scientist, I could have starved intellectually in the midst of a feast that was fit for a king. Being neither, I hope, I enjoyed myself, may have helped others enjoy themselves and know of a few practical things I did that the academic specialist would never have considered. During the last few weeks, my office has been the mecca for a steady stream of students who have set themselves to become specialists, who could not find jobs for themselves and who asked me in vain to recommend them for many splendid jobs I know to be available.

It was stimulating to work with the western section of the American Nature Study Society in Los Angeles. It was fun to take part in the program of the West Coast Nature School in Sequoia National Park. It was challenging to work at Oakland with the National Science Teachers Association, and it was really worthwhile to try to integrate, at the N.E.A. meetings in San Francisco, the varied views on conservation of the 125 participants from 22 states, with the group about evenly divided by the Continental Divide. In spite of a parade of blaring bands outside, of poundings on the door, of firecrackers exploding illegally most of the time, there was no lack of cooperative interest on the part of the professional group interested in conservation education at the Independence Day meeting, or in the meetings that preceded and succeeded it. The only distressing part of that meeting was the unexplained absence of some of the local talent that had offered to participate, but just did not show up. This last meeting was particularly interesting because it brought together not only scientists but educators and laymen as well, and it pointed the way to a well-planned conservation education program, in school and out, from youth to old age. I rather think it succeeded in serving this wide area without losing the power which unquestionably goes with specialization.

Instead of having the specialist ignore the generalist, or the generalist ignore the specialist, these west coast meetings on the whole pointed out how each group could use the other with profit to both. It was hard to reconcile some of the Nature Study Society's emphasis on long field trips with the publicity one gets as to the blessings of California. It was hard to go along with the Science Teachers' recommendation that there

should be greater emphasis on conservation while field trips were to be considered "on the way out." (Or did they mean outdoors?) It was difficult to enthuse over the expressed wish of some leading educators that they be given funds to sponsor more educational meetings when they failed to be represented at the San Francisco meeting. But, on the whole, the summer meetings on the west coast in 1951 were worthwhile. I have heard of no easterner that regretted making the trip and many who regretted that they had not gone before.

It is the hope of this department of *Nature Magazine* that some of the westerners who so graciously extended us easterners their hospitality will find it possible to attend the Philadelphia meetings at Christmastime and let us help them in return. We cannot match the accommodations given us at Mills College, I am sure. We cannot match the scenery of California, but I rather think there is some help we can give them along other lines, and this we will gladly provide. Notice of the Christmas programs will appear in ample time in the pages of this magazine. We hope that the exchange of ideas that took place in the West may be continued and elaborated in the East in the near future.

Laboratory Jingles

From time to time our versatile Microscope Editor, Dr. Julian D. Corrington, has published in his department clever little parodies on popular songs, with the lyrics inspired by the laboratory and experiences therein. Now those that have been published in our pages, and others, have been gathered in a little booklet entitled "Songs for the Comparative Anatomy Laboratory." The booklet is a project of the Beta Omicron Chapter of The Beta Beta Beta Biological Fraternity, and any profits from it will be added to the scholarship fund of that Chapter. It is only a suggestion, but if each class in biology, and such, could be opened by group singing of one of these songs, the class session would get off to a good start. The sole distributor for this booklet is the University of Miami Bookstore, Coral Gables 46, Florida. Single copies are fifty cents, and a dozen or more in an order may be had for forty cents. Each class should have a supply sufficient for all members.

Sugar Cane Insects

"A Selected Bibliography of the Insects of the World Associated with Sugar Cane, Their Predators and Parasites" is the quite descriptive title of a 113-page publication prepared by Joseph S. Wade for the International Society of Sugar Cane Technologists, Honolulu, Hawaii. To the outsider it will appear amazing that the problem of sugar cane insects and their associates would give rise to so much entomological literature, but here it is, all in one place so far as reference is concerned.

AMERICAN WILDLIFE AND PLANTS

By Alexander C. Martin
Herbert S. Zim
and Arnold L. Nelson

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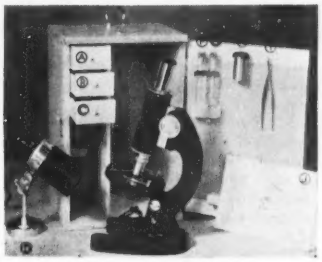

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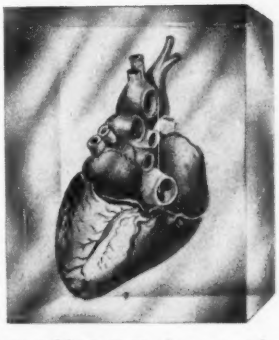

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Camera Trails

By
EDNA HOFFMAN EVANS

BEACHCOMBERS are not supposed to be very upstanding citizens. There are times, however, when I envy beachcombers. That is, I envy them their close association with actual beaches —the flotsam and jetsam, the shells, the crabs, and all the other small sea and shore creatures that they can see. So far as the extra-curricular activities of beachcombers are concerned, I am not interested, thank you.

But there is something about the open beach that gets me. There is a soothing, hypnotic charm about the broad ribbon of white sand that stretches ahead in the distance, bounded on one side by the swish of waves and on the other by the whisper of the wind in the tall grass.

I can wander along a beach for hours, completely oblivious of everything but my immediate surroundings — the sky, the sand, the waves, and the wind.

I can dream about Spanish treasure ships that once sailed these waters, and I can speculate as to whether any pirate's feet ever trod the same sands I am now walking. If they did, no doubt the ancestor of that sea gull watched them, and the ancestor of that crab did, too. Maybe these modern beach dwellers even have a family tradition telling where old Blackbeard, Henry Morgan, or Gasparilla buried their chests of stolen doubloons. It is fun to think so, anyway.

In order to dream like that, one must have an empty beach; one that is free of bathers and picnic lunches; one that is unlittered with broken pop bottles, banana peels, and other civilized debris. Beaches like that are scarce these days. I know of several, but it means a long drive to reach them.

There are numerous possibilities for photography at the beach — and I do not except bathing girls, either. In color or in black-and-white, the opportunities present themselves by the score.

In color, from my last trip, I have sea oats, sand, and sky — a symphony of blue and white, with a touch of gold for contrast. I also have an arrangement of sand dollars, both live and dry ones, plus a cornucopia of shells, with a casting rod added by way of a measuring stick.

The business of indicating size is something I have been working on lately. It is hard, unless some familiar measure is shown, to know just how large or how small something is. Projected, a color slide can make a grasshopper look as big as an elephant and a sand dollar as large as a cart wheel.

My camera was loaded with color. That is the difficulty of using two kinds of film, unless, of course, one also has a battery of cameras to use them in. I wanted some black-and-whites, too, particularly of the fiddler crabs.

So I caught a few fiddlers and took them home with me. They could be models after I changed film. Then, too, at home I could devote more time to them.

It is not hard to set up a simulated beach scene. Some white sand borrowed from a building project across the street was all I needed. Lacking that, other "props" could have served. I have known of photographers using sugar in the place of sand, especially when they wanted a particularly white setting.

I have never tried sugar, that has never been necessary. It sounds a bit wasteful, and sticky. But it is a trick worth remembering in case of necessity.

Since I was planning to take extremely close-up pictures, my "stage" did not have to be large. It was a square dish with a side measurement of exactly 9-1/8 inches. My models measured about two inches from one side to the other, so a nine-inch stage gave me room to spare.

This is the "beach" — a "stage" measuring 9⅛ inches square. For closeups only a small setting is needed. At the left, a front view, closeup of Mr. Fiddler.

Close-up photographs are frequently the ones most desired, and, at the same time, the hardest to get with an ordinary camera. By an "ordinary" camera I mean one that is designed to take good, bad, or indifferent pictures from a distance of three feet or more.

A double extension bellows helps on cameras equipped with a bellows. So does an extra portrait attachment or copying lens. But I think the best way to lick the close-up problem is with a special set of extension tubes. These, of course, are made to fit definite cameras.

The set I use on my Kine Exakta II is in five parts that all screw neatly together into a 3½-inch tube, or come apart in

sections of varying lengths. I can get a variety of combinations with them.

Without the tube, my camera will focus down to a little less than three feet — 0.9 meter, to be exact. With the shortest arrangement of extension tubes, my focusing distance is about eight inches. Thus, there is a space of about two feet, between my nearest focusing point without attachments and my furthest focusing point with attachments, within which I cannot take pictures. That is sometimes a handicap, particularly when I want to cover more space than my extension permits and less than my close-up without extension will allow.

But one cannot have everything with a camera.

Extended to their full length, my set of tubes allows me to get within three inches of my subject. Naturally, the field by that time is very small, and the depth of focus extremely narrow. Also, it is necessary to allow for more light in making the exposure.

Now to return to the fiddler crabs.

Not all of them had survived the trip home. Those that had not, made nice motionless models for long exposures. Those that had survived made lacy fiddler tracks across my sand stage, dug official-looking holes, and provided all the necessary realism for the scenery. Chasing them also provided a bit of variety, exercise, and recreation for the photographer.

I made the pictures in bright sunlight. The exposure meter registered almost the full amount of light possible when trained on the white sand that reflected back the brilliant sunlight. There was plenty of shade available and photography would have been much cooler therein. But I was striving for realism and there is no shade on the beach where the fiddlers congregate. In most cases I could stop the lens down to as much as f:20 and shoot at 1/100th. I was using Plus-X film with a daylight value of 50.

With such extreme close-ups it is necessary to hold the camera very steady. This is a "must" with all pictures, but it is especially so with close-ups. The slightest sway backward or forward throws the object out of focus.

I purposely did not use a tripod. I was curious to see whether I could hold the camera steady. In most cases I did. It is amazing, though, how much motion our bodies have, even when we think we are holding absolutely still. And, sometimes, the harder we try to hold still, the more we seem to move.

The fiddler pictures on my improvised miniature beach were successful, as the results indicate. In shots like these I try to allow for some margin of error. It is better to take several shots and be reasonably sure that one from the group will be good. It is disappointing to stake all hopes on one shot, and then have something go wrong with it.

Of course, there are times when only one shot can be taken. It is best to train one's self to be exact every time. But, depending on circumstances, I prefer to work more slowly and do some experimenting as I go along.

Of the 18 shots I took of the fiddlers, one is badly underexposed, two show movement on the part of the camera, and one is definitely out of focus. The rest, if I do say so myself, are pretty good. But under the conditions by which they were taken, they ought to be good.

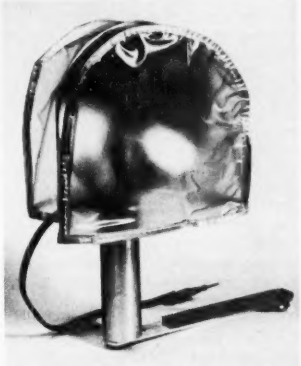
Ansco's new 8mm Daylight Type Film and magazine for movie cameras.

NATURE SALON

Here is an announcement of interest to all who want to see how their pictures compare with those of other Nature photographers.

The Kentucky Society of Natural History will sponsor its eleventh annual salon of Nature photography, November 25 through December 9, at the Louisville Public Library. Closing date for entries is November 14.

Entry fees are $1.50 for four prints and $1.00 for four slides. For further information and entry blanks, write to Dr. W. F. Furnish, Salon Chairman, Box 81, University of Louisville, Louisville 8, Kentucky.



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I received a neat little gadget the other day. It is called the Ingento Flash Color Guard. The guard is designed to fit over

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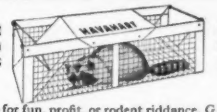

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the reflector of a flash gun and it prevents any damage that might be done when and if a flash bulb explodes in action. One side of the plastic fabric guard is clear for use with black-and-white pictures and the other side is blue to act as a filter with color shots. I have never had a flash bulb blow up, but they have gone off in my hand — not a nice feeling, I know! Burke & James, Inc., 321 South Wabash Avenue, Chicago, is distributor for the guards. The cost is 49 cents per guard.

In the color field, Ansco has recently announced two new types of color film, one for still cameras and one for movies.

In the still field, the new Plenacolor is available in 120 and 620 sizes. Depending on the size of the camera, there are six, nine, or twelve pictures possible per roll. Developing and federal tax are both included in the original purchase price of $1.45 per roll, while standard-sized prints from the developed color negatives can be ordered from any photographic dealer for 36 cents each. The film can be used in any kind of camera. Complete directions for using accompany each package of film.

In the movie line the new product is Ansco 8mm Daylight Type Film, packaged in "twin-eight" magazines to produce 50 feet of 8 mm motion pictures. It sells for $4.50, including tax and processing. Ansco 16mm Daylight Color Film, which has been on the market since 1944 in roll form, will now be available in magazines.

TERCEL, KING OF THE AIR

(Continued from page 405)

out for the beaches of the South. Next morning there were as many more, for the fall migration had begun, but Tercel soared alone above the valley. They needed him no more, these two remaining chicks; his cares were over for another year.

A new exhilaration filled the peregrine. Skies were blue and food was plentiful. With only himself to feed there was time again for play, for soaring high in the clear upper air, for breath-taking plunges at some stupid fowl, only to side-pass the bewildered creature he did not need for food. Sometimes he skimmed low over the water, herding the ducks like frightened sheep before him, until at last, tiring of the sport, he left them dishevelled and unharmed.

Then at last he, too, felt the tinge of autumn, and when next a southwest wind whipped the rushes till they doubled over the frothing water, Tercel set his wings and sailed up the valley. Beyond the divide that marked the boundary of his range, he veered toward the eastern mountains, following the age-old flyway that hawks had flown long before the Red Man roamed these hills.

High above the wooded summits Tercel glided effortlessly on the air currents, with scarcely a motion of the long pinions except to set them into the wind. Stooping whenever hunger prompted, roosting at night in some secluded spot, he shunned the crafty ways of man. Other hawks he avoided, too, both of his own kind and the numerous other species that use this eastern flyway, for except at nesting season a hawk is a solitary creature, whose rapacious habits demand a wide territory.

Thus in time he reached the sunny beach where he had passed his previous winter. When spring blows up from the Gulf, Tercel will return to the aerie in Forgotten Gully, to lure another mate to join him. Now the King of the Air hunches, alone, upon his solitary stub, silent and fierce and free.

FLOWER TOYS AND GARDEN PASTIMES

(Continued from page 416)

Picture books were colored with natural pigments provided by a variety of plants. Peony petals were crushed to give red paint, and a lovely blue was obtained from the dainty spiderwort. Goldenrod, marsh marigolds and trout lilies were boiled to make yellow. Pokeberries yielded a rich purple, and was used as ink.

Garden playthings did not end with summer, and the long winter evenings before the roaring fire could be spent stringing rose hips, or forming dolls' furniture from burdock burs. Woe to the mischievous lad who committed the unpardonable sin of sticking burdock burs in his sister's curls.

Spruce cones were gathered for the fire, the largest being rolled in earth and sprinkled with grass seed for an indoor growing thing. Pine needles were tied into tiny brooms for the doll house, or woven into necklaces and bracelets. A sprig of pine, its needles trimmed so that it stood upright, was known as a lady, who would dance gracefully, when blown gently over a sheet of paper. Outdoors, twigs and evergreen branches were sprinkled with water and frozen into miniature fairy gardens, which glistened like jewels in the winter sun.

From the blooming of the first snowdrop, until November winds rattled the dried stalks of the perennials, the garden was an exciting place for the child of yesterday. Perhaps you are familiar with these flower toys, or recall others which there was not space to mention, for children throughout the years have devised nearly as many playthings as there are flowers.

Country children still amuse themselves with these playthings, as did their grandmothers before them, and these flower customs will, it is to be hoped, survive as long as there are children and gardens. Life began in a garden, and for many who enjoyed a garden childhood, heaven could be no nearer earth, than to be a carefree child once more, with a garden of blossoms to explore.

Nature Photography

"Nature Photography with Miniature Cameras" by Alfred M. Bailey is the title of the first of a new series of publications being brought out by the Denver Museum of Natural History, City Park, Denver 6, Colorado. The author is director of the Museum and a noted photographer and lecturer. This 62-page bulletin is profusely illustrated and the text, besides providing practical information suggested by the title, is a readable story of the author's widespread photographic experiences. Individual copies of the booklet in this series, which will appear under the group title of "Museum Pictorial," sell for fifty cents, plus six cents postage. However, for $1.50 this first number may be obtained and the succeeding four publications now projected will follow as issued. The titles planned are "The Story of Pueblo Pottery," "Nature Photography with High Speed Flash," "Fossil Mammals," and "The Laysan and Black-footed Albatrosses."

Gregg Has New Post

H. Raymond Gregg has been named chief of the interpretive branch, Natural History Division, of the National Park Service, turning over the office of chief naturalist of National Capital Parks to W. Drew Chick, Jr. With the National Park Service since 1933, Mr. Gregg was first naturalist at Hot Springs and then, for eleven years, naturalist at Rocky Mountain National Park. As head of the interpretive branch he will be concerned with natural history research in the parks and coordination and improvement of the interpretive service for visitors to those areas.

Montezuma Birds

"Birds of Montezuma and Tuzigoot" is the title of the first in a projected series of booklets on the birds of our National Parks and National Monuments. It is the work of Henry H. Collins, Jr., with illustrations in color and black and white by Roger Tory Peterson. This first leaflet, which is available from Montezuma Castle National Monument, Camp Verde, Arizona, for twenty-five cents, pictures and describes the more common birds of the area and provides a complete check list of all the birds that have been reported there. The text is in popular form for the interest and use of the visitor who may know birds only casually, or even not at all. When comparable booklets for all of the areas under National Park Service jurisdiction are available a real need will have been met.

Springer Spaniel

The Springer Spaniel. By Maxwell Riddle. Chicago. 1951. Judy Publishing Co. 192 pages. Illustrated. $3.50.

This is a third edition of this thorough discussion of the history, breeding, care, showing and training of this breed of dogs.

HOW STARS DIFFER ONE FROM ANOTHER

(Continued from page 437)

Many stars are variable in light and this variability arises from one or two fundamentally different causes. The star may have its light cut off periodically because a companion star revolving around it comes for more or less brief periods between us and the principal star and eclipses it. For this to occur the intervening star must cross our line of sight. Such stars, viewed from another part of space, would not be variable in light. Stars of this type are known as eclipsing binary stars. The other group of variable stars, consisting of stars with many varied and complex types of variability, are variable because of physical changes taking place within the stars themselves, or in the gaseous envelopes that may surround them. In this group will be found the cluster variables, of greatest importance to astronomers because they render it possible to obtain accurate estimates of their individual distances in space, or that of the clusters in which they are found. Their light changes take place with the greatest regularity. One could almost set a watch by the regularity of their rhythmic pulsations. Their absolute magnitudes are constant at nearly 100 times that of the sun. It is this fact that makes them of such value in determining the distances of the objects such as the great globular clusters in which they are found.

It is impossible, for lack of space, to go into the characteristics of the many varied types of variable stars, the long-period variable stars, the irregularly variable stars, the unpredictably variable stars, and many others of great interest. It may be possible later to consider these variable stars, a large and very important class of stars.

Our own sun, among all those that have been mentioned for their great differences one from another in brightness, size, color, temperature, mass or density, stands forth as a quite normal star. It is neither very great or very small; very brilliant or very faint. It is neither excessively hot nor feebly radiating. It is not a variable star to any appreciable extent. It is not a double or a multiple star. Its only companions are planets, not stars, and they revolve around it and depend upon it for such life as exists upon any of them. So far as is known it is the only star that has a planet encircling it upon which life exists. It would be unreasonable to assume, however, that it is the **only** sun that has a satellite upon which life exists.

So far away are the stars that it is impossible to detect the existence of planets upon even the nearest of them, by any means we now possess.

The planet Mercury will be in superior conjunction with the sun on October 13, and too near to the sun to be seen this month. Venus is now in the morning sky before sunrise and will be at its greatest brilliancy on the October 10. Mars is in the constellation of Leo, rising after midnight. It is now of about the second magnitude, and passes from west to east of Regulus and about a degree south of it early in October. Jupiter is in opposition to the sun on October 2, and is visible all night. It is near the boundary between the constellations of Cetus and Pisces.

Saturn is now in the morning sky, too close to the sun to be seen until late in the month.

Nature Study Course

So successful was a course in bird identification offered at George Washington University in the national capital, and conducted by Roger Tory Peterson, that the university authorities are awakened to the popular interest in Nature. They have, therefore, announced an eight-week course, starting in early October, in the College of General Studies. The course, which will be conducted by W. Drew Chick, chief naturalist of the Office of National Capital Parks, is designed for leaders of youth groups, teachers and others who wish to acquire a fundamental understanding of the geology, plants and animals of the Washington region. Nature projects suitable for teaching children will be described and demonstrated, and field trips will be held.

Going Light

Going Light with Backpack or Burro. Edited by David R. Brower. San Francisco. 1951. Sierra Club, 1050 Mills Tower. 152 pages. $2.00.

This is the joint work of ten of the active members of the Sierra Club, plus the editor, and is a handy little volume designed to be of practical aid to anyone who would enjoy wilderness trails, chiefly in the West, without superfluous equipment and expense. All the contributors know thoroughly whereof they write, for they are all experienced mountaineers and wilderness-goers. Camping and camping technique, food and cooking, equipment, maps and compasses and mountain medicine are among the chapters. There are also chapters on women, men and children, and one on management of burros. It is truly a most useful little book.

History of Astronomy

A Concise History of Astronomy. By Peter Doig, with a foreword by Sir Harold Spencer Jones. New York. 1951. Philosophical Library. 320 pages. $4.75.

This is the first general history of this kind to appear in English in some forty years, a period that has seen great progress in astronomy and the making of history. Therefore this book should fill a need not only for those wishing to get the whole picture of astronomical history but as a reference source on the main events in astronomy and on the contributions of individuals.

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IN MEMORY OF SPRUCE

By C. E. Gapen

Plant scientists who comb the jungles of tropical America, as the U. S. Department of Agriculture rubber tree scientists do, honor the memory of their great predecessor, British botanist Richard Spruce, who began his epochal explorations in the Amazon Valley just a little more than 100 years ago. In writing a leaflet for the Harvard Botanical Museum on some of his own recent explorations in this region redolent of Spruce, Dr. Richard Evans Schultes, botanist of the Bureau of Plant Industry, Soils, and Agricultural Engineering, dedicates it to him. Spruce's statements, he says, "reveal the inner soul of the man," in the "most honest presentation of the underlying motives of phytogeographical endeavors."

Two of the statements that stimulated another jungle-defying botanist to unburden himself in this manner a century later are given here.

To a fellow scientist in England Spruce wrote, in 1851, from the Amazon wilds: "Then there is that greatest of all pleasures to the naturalist, however some utilitarians may affect to undervaluate it, that of discovering new species, of dotting in (as it were) new islands on the map of nature."

Later, to another botanist, he wrote: "I have lately been calculating the number of species that yet remain to be discovered in the great Amazonian forest, from the cataracts of the Orinoco to the mountains of Matto Grosso". . . and find "there should remain 50,000 or even 80,000 species undiscovered. . . I resigned myself to the sorrowful reflections that I must leave all these fine things 'to waste their sweetness on the desert air'." Schultes keeps his memory green when he says: "Spruce's work remains the most complete phytogeographic labor ever carried out in America."

In this day, with so much comfort, convenience, and efficiency based on rubber, it is well to remember a man who did so much to lay the foundations of knowledge of types and species of plants that are now the principal sources of its raw material all over the world.

MARVIN AND MIRANDA

By Anna King Davis

In our garden, autumn is a leisurely, friendly season. The rushing days of summer are followed by days of rich repose. Nature herself is relaxed and whimsical. She puts wings on milkweed seeds and makes musicians of humble brown crickets. She makes peppers glow like rubies, and among coarse gray leaves hangs the sapphire egg-plant. The birds take time to be friendly; the ragged cardinal lingers at his sunflower seed, the wren visits between caterpillar hunts. In his leisurely flight through the sky, the bluebird drops liquid notes of melody. My husband and I find ourselves lingering long in this place, pleasant with sun and the drone of bumblebees.

We were to share the pleasures of our garden with another couple — Marvin and Miranda. Miranda arrived first. We discovered her one autumn morning — *Miranda aurantia*, a female garden spider more than an inch long, her black body handsome with orange-gold spots and bands. She was in the center of a beautiful wheel-shaped web, which she had hung over a bare space in the honeysuckle clump. My husband and I paused to marvel at the delicate perfection of the huge web, fully two feet in diameter.

Miranda interested us and we visited her often. Usually she was hanging motionless in the center of her web. Sometimes she was feasting on a small, shrouded insect. If we found her web empty of food we would toss a cricket or grasshopper into it. We liked to watch her dash out to the entangled victim and wrap him in sheets of silken web as quickly and deftly as a butcher wraps and ties a package of meat.

At last Marvin arrived. He found Miranda's web immaculate and perfect. A fiddler cricket on a nearby stem played constantly, monotonously. It was late that afternoon when we saw Marvin, a male garden spider about a fourth as long as Miranda and of a sober brown color, banded with white. He was on the ground below Miranda's web, hurrying away from the honeysuckle clump. Evidently he had called on Miranda, courted and married her, then scurried away lest Miranda make a wedding feast of him. That was our only glimpse of Marvin.

Soon the fall rains came. Miranda's beautiful orb web was torn to tatters. Miranda herself disappeared; but not before she had provided for the spiderlings-to-be. In the top of a small shrub was the pear-shaped eggsac, about the size of a hickory nut — a soft, silken nursery for the offspring of Marvin and Miranda.

L. W. Brownell

In the first issue of *Nature Magazine* (January, 1923) appeared an article on the red birch, written and illustrated by L. W. Brownell. Through the years Mr. Brownell's articles and pictures have appeared regularly in our pages, and a great many of his fine pictures have provided pictorial features. On June 17 Mr. Brownell passed away suddenly at his Paterson, New Jersey, home from a heart attack. Through the years this careful naturalist-photographer had built up an outstanding file of negatives of Nature photographs, principally of trees, shrubs, flowers, reptiles, amphibians, and insects, although his subjects also include birds and mammals. He wrote widely on both Nature and Nature photography, and his pictures have illustrated many textbooks in the natural sciences. Mrs. Brownell will continue to make available prints from this notable collection.

American Bird Songs

American Bird Song records, Volume Two, will be welcomed by bird-lovers, everywhere. This new volume of five twelve-inch, vinylite records, ten sides, in a decorative album, is a worthy sequel to Volume One, which has brought to thousands of bird lovers the voices of 72 of America's most familiar birds. The new volume adds fifty-one new recordings of bird songs, only two of which duplicate songs in the first volume. The singing birds were recorded in their native habitats by Drs. L. P. Kellogg and A. A. Allen of Cornell University. They were able to apply some new techniques which have made the quality of this second volume even finer than that of the first. We have played these records on our radio-phonograph, 78 R.P.M., and can vouch for the high fidelity of the bird songs. The new records bring America's songsters right into your living room.

To Havasu Canyon

Joseph C. Wampler, archaeologist-mountaineer of 1940 Hearst Avenue, Berkeley 9, California, is conducting eight-day trips to Havasu Canyon within Grand Canyon National Park. The first left on September 21, but others will leave in October and future series are planned.

Oops! Sorry!

In our recent notice of the publication of the magazine *North Country* either one of the four fingers we use for typing slipped, or the linotype operator did us dirt, and the proofreader compounded the error. We said *North Country* costs $2.75 a year. It does not; it costs $2.25.

Egg Collection

Reminiscent of the days when the oologists made real inroads into our bird population, is the announcement from Wilson College, Chambersburg, Pa., of the acquisition of a collection of birds' eggs totalling more than 2000 eggs. The collection was purchased from Frank E. Webster of Hyde Park, Mass., and is historic. The eggs bear, in many cases, the original labels and some of the dates are as old as 1861, while place names are world-wide. Dr. Grace E. White, chairman of the Wilson biology department, believes the collection one of the finest in any American college.

Yellowstone Portfolio

Twelve black and white photographic studies, made in Yellowstone National Park by Franz Lipp, have been gathered into a most attractive portfolio by Henry Regnery Company, 20 West Jackson Boulevard, Chicago 4, Illinois. Of these selections A. E. Demaray, Director of the National Park Service, has said that the photographer has captured "the 'feel' of the Yellowstone forests, meadows, mountains and canyons." These studies are among those exhibited in a showing of Mr. Lipp's work at the Art Institute of Chicago. The portfolio is offered at $1.50.

THE READER'S MARKET

A place where members of the American Nature Association and readers of Nature Magazine may find many interesting offerings or may advertise themselves, at low cost, for things wanted; things they have for Sale, for Trade, for Sale or Trade. This is an excellent forum for acquiring or disposing of such items as binoculars, books, cameras and photographic equipment, magazines, sports and outdoor equipment, etc.

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UNDER THE MICROSCOPE

By JULIAN D. CORRINGTON

PHASE-CONTRAST MICROSCOPY

1. The Phase-Contrast Principle

ONE OF the most recent developments in microscope methods is the principle of phase contrast, a new way of controlling light so as to heighten contrast. In order to understand this procedure, it will be necessary to review some of the fundamentals concerned with the formation of a magnified image in a microscope. For the physicist, this would be done entirely by means of mathematical equations, quite beyond the ken of ordinary mortals; for the layman, the attempt is here made to draw word pictures of the nature of light and of what happens to it in a traverse of a specimen and an optical instrument, and it must be emphasized that these word pictures are unreal and only an approximation to the truth. Nevertheless, they help give some sort of comprehension of what transpires.

Transparency Versus Contrast

The preferred method used in studying most objects under the microscope is by transmitted light. Materials vary in density and are seen as differing shades or tones of substance, but are generally darker than the brightly illuminated circle of background light, whence this practice is termed *brightfield microscopy*. In order to transmit light from below the stage, the objects must either be very thin and more or less transparent, or must be made so by smearing or sectioning techniques. If we take a drop of culture of the well-known amœba and mount on a slide under a cover glass, we have created for ourself a serious problem in visibility: — the living protoplasm is so nearly colorless and transparent that it is difficult to distinguish in its watery environment. There is too little *contrast*. The ultimate along this line will be seen, — rather it can *not* be seen, — if we place a colorless glass bead in a small vessel or testtube of benzene. The bead promptly disappears! Contrast has dropped to zero, and the reason will shortly be forthcoming.

The opposite extreme is complete visibility with complete opacity, as placing a flake of slate on the stage of the microscope, then attempting to see through it; an absurdity, of course, the rock structure being too dense and the piece too thick. Much of the procedure in microtechnique is directed toward securing a satisfactory compromise between transparency and contrast. We stain for contrast and clear for transparency, and make thin sections of opaque objects that can be cut, or grind down exceedingly thin wafers of such things as rocks and minerals that cannot be cut.

We can improve visibility of the amœba and its parts by killing the animal and using one or more stains. A carmine dye will color the whole cell red, but the denser nucleus will be darker red than the cytoplasm and so be revealed; or we can color the nucleus red with safranin and tint the cytoplasm with fast green, for greater contrast. These dyes absorb certain wavelengths of light and transmit others, producing a sensation in our mind that we distinguish by such a name as red, or green, or blue. We have gained contrast, but we have killed the animal, and so lost the possibility of watching it in action. Also we are not sure to how great an extent the reagents used to kill, fix, stain, clear, and mount have altered the original structure or introduced precipitates or other artifacts. It is generally assumed that most operations in microtechnique bring about distortion and the effort has been to keep this to a minimum. Most dyes are fatal to living tissue, but certain ones known as vital dyes (intra-vitam or supra-vital staining), can be used to stain cells without killing them — neutral red is an example. Their use is quite limited, however, and they have not solved the general problem. Phase microscopy is especially designed to heighten contrast in the fine detail of transparent and colorless material, living or inorganic, freshly prepared and in the natural state.

Refractive Index

Light proceeds away from a luminous body in straight lines in every direction at a uniform velocity of 186,000 miles per second. When traveling in a vacuum, its speed is unimpeded by any substance whatsoever, but when it enters air, water, glass, or other transparent media, its velocity is reduced. The ratio of the speed of light in a given substance to its speed in a vacuum is the refractive index of that substance. Refractive index, indicated by the symbol n, is thus a quantitative expression of the relative optical density of a material. Since all substances are denser than a vacuum, which is assigned the arbitrary numerical value of 1, all refractive indices are greater than 1 — air, for example, being 1.0003. This is sufficiently close to 1 for all practical purposes, so the comparison is generally made with air rather than with a vacuum. Water has n 1.33, benzene 1.503, the average crown glass 1.52, Canada balsam 1.52.

One practical result for the microscopist of a knowledge of refractive indices is met with in processing diatoms as permanent slide mounts. Since diatom shells are silica, like glass, and since Canada balsam has the same or nearly the same refractive index, the shells are invisible, or almost so, when in balsam. Hence the diatomist has searched for resins of either

Sir Issac Newton demonstrates the spectrum.

lower or higher n than balsam, and prefers such media as Styrax, n 1.63 or Hyrax, n 1.82. These increase contrast without diminishing transparency. Here, too, is part of the explanation for the invisibility of the glass bead in benzene. Another and much more important use for refractive index is for identification of unknowns. Since each substance has its specific n, it commonly may be known by ascertaining that property with a refractometer. Determinations must be made at a standard temperature and with a designated monochromatic light, as the D line of the spectrum, a yellow light produced by burning sodium or its compounds.

Deviation

A ray of light meeting a transparent substance at a normal (a perpendicular to the surface) passes through without bending. It is retarded but not *refracted*, i.e., bent into a new direction. If, however, the incident (entering) ray meets the surface at any angle other than 90°, it is *deviated* (refracted or bent) and the amount of change of direction depends on the angle of entrance and the optical density of the substance. For a given incident angle, the angle of refraction will vary directly with the refractive index of the material. This gives us another definition for refractive index: n = the ratio of the sine of the angle of incidence to the sine of the angle of refraction. To say that water has n 1.33 whereas glass has n 1.52 means that a ray of light entering glass from air at a 30° angle of incidence will be bent more than a ray of the same obliquity entering water from air. Refractive index is then a measurement of the light-bending powers of different media.

Long ago Pierre de Fermat (1601-1665), French mathematician, discovered the fundamental law governing the traverse of light rays through an optical system. It is called the *principle of least time*, and indicates that a given light ray will pass straight through or deviate in such a manner as to take the shortest *optical path*

through any object. The optical path is the shortest way through for a light ray. The ray tends to travel in a straight line, but in passing through objects of varying densities, the velocity of the ray is altered, being slower in the denser media, and the deviation will correspond. The optical path is determined by multiplying the thickness of the object by its refractive index. The pathway through the nucleus of an amœba would be expressed by one quantity, through the contractile vacuole by another, for these two objects differ both in thickness and refractive index.

Dispersion

Life for the optical scientist would be far simpler, but for all of us much less interesting without color. Sir Isaac Newton, in 1672, with his famous "experiment of colors," demonstrated that "white" light, as from the sun, is not uniform, but contains all the colors of the rainbow. He passed a beam of sunlight through a prism (one of our illustrations recreates this scene) and found that the white rays were *dispersed* into a *prismatic spectrum* — red, orange, yellow, green, blue, indigo, and violet, wrote Newton. Doubtless this use of seven as the number for all colors is merely another survival of numeralogy, for no one else has ever claimed to have seen Newton's "indigo," and actually there is an infinite series, one blending into another so that it is impossible to demarcate the separate "colors" in a spectrum.

The wavelengths that make up white light are so exceedingly short in comparison with anything familiar, as water waves or sound waves, that a new yardstick was needed to express their measurement. This was provided by the Swedish physicist, Anders J. Ångström, in 1868, with his Ångström Unit, or A. U., now generally written simply *angstrom*, and abbreviated A. This unit is the hundred-millionth part of a centimeter: 1A = 0.00000001 cm., or 1A = 10^{-8} cm.

Color is subjective and does not exist as such in nature at all. Wavelengths of radiant energy within the range 7800A to 6300A, when perceived by the eye, produce a sensation in the mind that we interpret as "red" of various shades. Below 7800A, in the infrared, the vibrations cannot be seen as visible light at all. Orange is the way we see radiations between 6300 and 5900A, while yellow ranges from 5900 to 5500A; green, 5500 to 4900A; blue 4900 to 4500A; and violet, 4500 to 4000A. Shorter wavelengths, in the ultraviolet, can be photographed, but cannot be detected by eye. The shorter the wavelength the higher the frequency of vibration; times per second. The longest visible wavelengths in the red end of the spectrum are produced by 4.3 x 10^{14} vibrations per second, while the shortest wavelengths in the violet end exhibit 7.5 x 10^{14} v.p.s.

Newton's spectrum is a fanning out of all the wavelengths c[illegible]ising visible light into a linear series, and today's explanation is that the speed of each different frequency of vibration through the glass of the prism varies, red light traveling faster through glass than green light, green traveling faster than blue. Inasmuch as the amount of deviation depends on the velocity, red is deviated least, green more, blue still more, and violet most. This fans out or disperses white light into a rainbow spectrum. One of the more difficult problems in microscope manufacture is to get all of these component colors of white light back together again after they have been dispersed while being deviated through lenses for purposes of securing magnification.

Diffraction

The diffraction of light was discovered more recently than such phenomena as reflection or refraction, and is still unfamiliar to the public, yet anyone may observe it with ease by any of a number of simple experiments. With a razor blade, cut a three-inch slit in a card — a 3 x 5 index card will do, although a black photomount is better. Hold the card close to one eye, the slit vertical, the other eye closed, and look through the slit at the blue sky (day) or a lamp bulb (night). The fine black lines seen running lengthwise in the slit are *diffraction images* of the edge of the slit, or *diffraction patterns*, and prove that when light passes by the edge of some object, in this case the slit, the marginal rays bend slightly outward. Or hold a fine-toothed comb in front of one eye, from six inches to one foot away, the comb vertical, the teeth horizontal, the other eye closed, and look through the teeth at the blue sky. The fine spurious teeth seen are diffraction images. If you will sit about three feet from a screened window, and look out the window through the comb, you will see something both amusing and startling.

After a moment's practice, you can look between two very slightly separated fingers held before the face, or look at objects between eyelids nearly closed and achieve diffraction effects. Upon entering a warm, moist room, or a closed, hot, parked automobile from outside, those wearing spectacles will have the lenses clouded with mist. If now they can look at a point source of light, as a lamp bulb or street light, they will see a series of alternately light and dark circles. Here the fine droplets of water on the glasses have acted like a diffraction grating. Diffraction may be defined as the spreading of any wave disturbance into the region behind any obstacle, and applies to sound and other wave phenomena, as well as to light.

Interference

In 1801 the London physician, Thomas Young, explained his discovery of interference and startled the scientific world by combining two waves of light in such a manner as to produce darkness. One wave cancels another out or brings about extinction. Young sent a beam of light through a small opening in a screen (fig. 1).

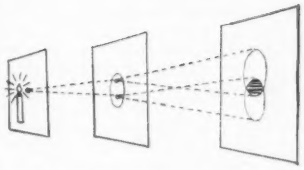

Fig. 1. Thomas Young's experiment to show interference.

Light spread outward by diffraction from this first orifice so as to illuminate equally two small and close apertures in a second screen and, similarly, continued from both of these so as to cast a circular spot of light, one from each secondary aperture, on a third screen. This last was so placed that the two circles of light, from the openings in the second screen, were made to overlap in part, and where this occurred there appeared a series of light and dark lines. The explanation is one essential to our present discussion.

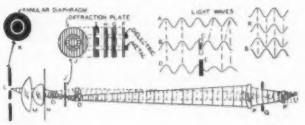

Fig. 2. A. O. explanation of phase microscopy.

Phase

In figure 2, under "light waves," line A shows the symmetrical oscillation of an otherwise undisturbed light wave. Line B shows another wave from the same light source, passing through a transparent but dense substance (C) which slows the velocity so that the crests and troughs of this wave lag behind those of wave A. Wave B is now *out of phase* with A. Waves R are traveling in the same phase — crest with crest and trough with trough — and where they illuminate a screen or some other object, they would augment each other, making the illumination brighter. This is *constructive interference* or *reinforcement*. Waves S, however, are in opposite phase, trough traveling with crest, one wave being half a wavelength behind the other, and where these overlap they will produce *destructive interference* or *extinction*, yielding darkness. Put another way, one wave produces a displacement in one direction, the other wave produces an equal displacement in the opposite direction. These two displacements nullify each other and result in no light. Cases in between, as waves A and B, which are not out of step as much as ½ wavelength, give various shades of gray.

Returning to Young's demonstration (fig. 1), light from the upper opening in screen 2 must travel farther than light from the lower opening in order to reach the lower part of their area of overlap on screen 3. There is a certain distance be-

low the center of this common field where the two light waves will arrive out of phase by ½ wavelength, and will cancel out, making a bar of darkness on the screen. Below this, the two waves will arrive at one zone after having traveled routes of sufficiently different length so as to be 1 full wavelength apart and will be in phase and reinforce each other, making a bright bar. Still farther down, the two will be out of phase again, this time 1½ wavelengths difference in distance, and a second dark bar appears. This continues to the edge of the area of overlap, and is repeated above the center. It was this simple yet convincing demonstration that provided final and conclusive proof of the wave theory of light, no other explanation being possible.

The bright zones are termed maxima and the dark ones minima. If a monochromatic (one-color) light is used, the maxima are of the color selected and the minima are black; i.e., with yellow sodium light, the maxima are yellow and the minima black. With white light the maxima are not white, however, but appear as spectra, since diffraction as well as refraction bends light rays, resulting in a sorting out of wavelengths. The diffraction spectrum appears in the opposite sequence of colors from that shown by the prism. Rays of the highest frequencies are diffracted least, these being the violet and blue with the shortest wavelengths, while the red waves, longest and with lower frequencies, are diffracted most. The brightest spectra appear nearest the center of the screen images, each being a first-order spectrum. Next would come the second-order spectra, and so on outward, each becoming progressively dimmer. The colored bands or successive orders of spectra are due to differences in length of path of the two rays of light of whole numbers of wavelengths — 0, 1, 2, 3, etc., while the dark zones with no light are due to path differences of multiples of ½ wavelength, as ½, 1½, 2½, 3½, etc. Another way of expressing the same law is the statement that bright zones are due to even numbers of ½ wavelength, as 1, 2, 3, and dark zones to odd numbers of ½ wavelength, as ½, 1½, 2½, and so on.

Amplitude

The maximum displacement of a wave from its mean, or from its position when at rest, is its amplitude. The height of the crest of a water wave above the general water level when calm, or the depth of the trough, would be an example. Light is not so simple as this, but nevertheless has its amplitudes, which measure the *intensity*. One light may be obviously much more intense or stronger than another: intensity varies with the square of the amplitude.

In fig. 2, line D shows a wave starting with the same phase and amplitude as wave A, but a very thin coating of a metal (E) partially blocks the path. The metal absorbs much of the light, but that which gets through continues on as if there had been no barrier; the intensity has been altered, as shown by drawing the wave with lessened amplitude, but the phase is not changed. An analogy would be the light entering a room during the day. If we pull down all the shades, the room is dimmed but not rendered dark; enough light gets through so as to illuminate all the objects in the room, but its intensity has been greatly reduced.

From the discussion of interference, it may be seen that *phase differences result in amplitude differences*. The human eye cannot detect phase differences as such, but notes only their intensity effects. For instance, if two light waves of the same amplitude and phase arrive at one point together so that one is superposed on the other, their amplitude is doubled and we see twice as bright a light; if they are of opposite phase, the amplitude becomes zero, and we see no light at all.

Numerical Aperture

This factor, abbreviated N.A., is one of the most important considerations in microscopy, and was one of the many productions of the German mathematician and physicist, Ernst Abbe (1840-1905), who did more for microscopical science than anyone else. The formula is N. A. $= n \sin u$. n being the refractive index of the medium surrounding the objective, and u being ½ the angular aperture of the front lens. Angular aperture is simply the width of the widest cone of light that can enter the objective. It is determined by taking the diameter of the front lens as the base of a triangle, the apex of which is a central point in the object. A low-power objective has a tall, thin cone of entering light, like a dunce's hat; a high-power objective, especially an oil-immersion, has a short, fat cone, like the paper cup of the soda fountain. In order to secure a right-angled triangle, half of this cone of light, i.e., a radius of the objective lens is used in place of the diameter. The sine of this angle of incident light is then obtained, and multiplied by 1, the n of air, if the objective is a dry lens, or by 1.52 if an oil-immersion. Example: the angular aperture of a 1.8 mm oil-immersion objective was found to be 110° 30′. Half of this is 55° 15′, and the sine of this angle is 0.82165, which is sin u. Multiplying by 1.52 gives the figure 1.25 as the numerical aperture of this objective.

Resolution

Numerical aperture is a measurement of the light-gathering capacity of an objective. The wider the cone of entering light, the greater the amount of incident light; also a column of oil between cover glass and objective will, by internal reflection and refraction, trap a wider cone of light than otherwise possible, preventing its escape, thus effectively widening the aperture and increasing the N. A. As examples, the regular achromatic low-power dry 16 mm 10X objective has N. A. 0.25; the high-dry 4 mm 43X has N. A. 0.65; and the oil-immersion 1.8 mm 97X has N. A. 1.25. Any value greater than 1 indicates an immersion objective.

Numerical aperture is also the quantitative expression for the *resolution* or *resolving power* of an objective, which is its ability to render fine details separately visible. Everyone knows that one function of a microscope is to present a magnified image, but the uninitiated generally do not know that magnification alone is worthless. We must not only be able to see an enlarged image, we must see detail in that image. Certain diatoms are commonly used as test objects for resolving power. These microscopic unicellular plants are often most intricately marked. A cheap, uncorrected microscope objective might give an enlarged picture of a diatom, but with a number of blurred shadows across the valve (shell) that would provide little if any information as to the structure present: this would be an example of *empty magnification*, that is, magnification without resolution. A better objective — a corrected one with higher N. A. — might show these blurs as definite lines; lines that could be counted and measured. If we went no farther, there our knowledge of this feature of diatom construction would rest. It has a series of fine lines engraved on its valves, function unknown. If a still better objective with higher N. A. were available, it might show that these supposed lines were not such at all, but each "line" rather a row of closely spaced and exceedingly fine pores, through which very minute processes might be extruded. Thus our knowledge of structure of the microcosmic world depends on resolution more so than on magnification.

A high resolving power is achieved, in the design and manufacture of microscope objectives, with great difficulty and expense. It would therefore seem foolish for the owner to use his costly equipment in any way other than that which secures the maximum resolution. For this result, he must employ Köhler illumination. Using the plane mirror surface, an image of the lamp filament is focused on the closed iris diaphragm of the microscope condenser, and then this diaphragm is opened and the condenser focused so that the lamp filament is imaged in the object field. The eyepiece is removed and the operator looks down the tube, closing the iris until the outline of its image coincides with the circumference of the back lens of the objective. In this way the objective is flooded with the maximum amount of light, the rays parallel as if from infinity, but excess that cannot be used is cut off.

Space limitations being what they are, we must leave the reader in a state of suspense until next month, when we continue the necessarily extensive discussion of this subject. Guard your copy of this issue carefully since it, with November, will provide an entity.

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